# *The* MOTOR BOAT
## Its Selection, Care and Use

HAROLD WHITING SLAUSON

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BY

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# CHAPTER I

## KINDS AND USES OF MOTOR BOATS

THE cheapest and simplest form of motor boat is the converted skiff. A substantial rowboat of the St. Lawrence model may be bought for from twenty to forty dollars, and for the expenditure of another forty or fifty a one or two horsepower motor may be obtained and installed—thus making a craft which should be able to carry three or four persons at a pace much faster than that of rowing and with much less exertion—unless the motor should prove to be balky. The best results will probably be obtained by something near a two horsepower motor in a boat of this type, as any power in excess of that would set up such a vibration in the hull that a ride in such a craft would be far from pleasurable.

Akin to the motor skiff, and yet of lighter weight and consequently of greater speed for the same power, is the ordinary canoe, strengthened and braced for the installation of the engine. The limit of speed in a motor boat of this kind will be about fourteen miles per hour, no matter how much power may be installed, but comfortable riding cannot be obtained with more than one horsepower, and a consequent speed reduction to about eight miles per hour. Motor canoes are made by some manufacturers with the engine already installed; these are found exceedingly useful in sections where portaging may be necessary, for the entire outfit will weigh less than one hundred and fifty pounds.

A "ready-made" motor boat with the engine installed and ready to run can be bought for less than one hundred dollars. While it is subject to the troubles to which the average motor craft is heir, the entire outfit is a remarkably simple little affair, and when owned and operated by a man who exercises common sense, it should furnish little cause for annoyance. Such a boat will probably be about fourteen feet long with the motor located in the stern and an arrangement for steering within easy reach of the engineer.

A couple of cross seats forward furnish accommodations for two or three passengers, while space is supplied for tools, camping utensils, oilskins, and the like under the seats. With a few gallons of gasoline in the tank, strong batteries for the motor, and a sufficient knowledge of the waterway to keep away from the rocks and shoals, an entire day may be spent on the water and many miles covered with no probability of a mishap or trouble of any kind with the engine.

Boats of this style are manufactured with the ordinary wooden hull, or with a hull of steel, according to the type purchased. The former are too well known to require comment here, but the latter, too, are becoming exceedingly popular with the man who desires a craft in which he can go almost anywhere and which is practically indestructible. These hulls, being made of pressed steel, are exceedingly difficult to puncture, and should a solid obstacle be encountered, a dent, which could probably be hammered out easily, will perhaps be the only damage incurred. As an additional safeguard, however, most of these steel hulls are equipped with air-tight steel tanks fore and aft which will serve to keep the boat afloat, even though a hole should be made in it below the water line.

Whether it would be to a certain man's advantage to buy one of these ready-made motor boats, or to purchase an engine and install it in a hull built at some other yard, will depend so much upon circumstances that it is almost impossible to give practical advice on the subject. The completed craft, being ready to run, will require less trouble in its purchase, and if the buyer can find just what he wants, it would probably be the better policy for him to obtain one of these. If he already owns a substantial hull, however, it would naturally be to his advantage to secure a suitable motor and install it in the boat.

Ordering an entirely new boat to specifications will insure exactly the type of craft the man thinks he wants, but a low-priced boat of the sort we are considering would hardly warrant the extra trouble involved in having the hull built to order and an engine of a different make installed therein. In general it may be said that when the investment represented is not over one hundred and fifty dollars the ready-made boat will be preferable to the built-to-order kind—unless the purchaser already owns a suitable hull or engine, or both.

A man of a mechanical turn of mind who desires to devote his spare time during the winter to an interesting and money-saving pursuit can do no better than to build his own boat—provided he has at his command a sufficiently large workshop and the few tools necessary. There are several methods by which he can do this, and either, when properly carried out, should supply him with a motor boat at considerably less expenditure of money than would be the case had he bought the craft outright.

Some manufacturers and designers furnish, for a small sum, a complete set of patterns, or forms, and blue prints, by the use of which a complete hull may be made. The actual cost of such a boat will consist in the few dollars expended for the blue prints and patterns and the cost of the raw material and hardware. Unless the man who is building the hull in this manner has at his disposal a small buzz or band saw, he must have some of the lumber cut for him at a sawmill, and this expense must be added to the cost of building the boat.

The " knock-down " boat could hardly be called a home-made affair, for the pieces are cut in the factory and merely assembled in the amateur builder's shop. Before shipment each piece is cut to fit accurately in its place and minute directions are given for every part. The cost of these parts is probably less than half the net price of the completed boat. The saving in freight from the factory to the water on which the boat is to be operated is another important item to be considered, and probably two thirds of this charge may be saved because of the more compact and convenient form in which the " knock-down " parts are shipped.

The building of these boats by the amateur is practicable only for hulls of the smaller sizes—

not exceeding twenty-four or twenty-five feet in length, let us say. Above this size, the parts become too large and bulky for him to handle, and the heavier tools required confine the building of such a hull to a well-equipped shop under the immediate direction of a professional boat builder.

Although new boats of forty, and even more, feet in length can be obtained with motor installed and the whole craft ready for operation, the majority of motor boats over twenty-five feet long are made to order from specifications furnished or suggested by the prospective owner or his adviser. A man buying a boat of this size has doubtless previously owned or operated a smaller craft, and by the time he has graduated into the large-size auto boat or cruiser class, he will probably know just about what he wants. Consequently the present chapter—written, as it is, primarily for the beginner—cannot well include points or suggestions on boats of these proportions. Between twenty-five and forty feet, however, many auto boats, cruisers, and "family boats" are in use by the novice.

Probably the majority of motor boats to-day under forty feet in length can be controlled easily by one man, and the owner, if he so chooses, may assume the role of the "cook, the mate, and the captain bold," and also the crew of his craft. To have under his control at the same time the speed of the motor and the guidance of his craft lends a zest and enchantment to motor boating which cannot be found in the larger yachts where the signals must be sent down from the bridge to the engine room located out of sight in the hold and on which the captain and engineer are hired professionals. Quick to realize this desire on the part of the average owner to operate his craft himself, the builders make a feature of the simple, one-man control, and modern design enables a forty-foot auto boat or cruiser to be handled almost as easily as a sixteen-foot runabout.

The auto boat is probably the type which excites the greatest amount of admiration from spectators and passengers as it skims lightly over the water at the rate of from fifteen to thirty miles an hour, and the prospective buyer immediately picks this out as the only kind of a craft that it will satisfy him to own. He need not be discouraged, however, by such seemingly hopeless ambitions, for it is really remarkable what a speedy, trim, and serviceable little craft may be purchased for fifteen hundred dollars or less. In fact, an auto boat about twenty-five feet long and capable of carrying six or seven passengers at the rate of twelve or fourteen miles an hour can be purchased complete for about five hundred dollars.

Modern hull design and motor boat construction have brought a boat with a speed capacity of twenty or more miles an hour within the reach of the man who has but a thousand dollars to spend for the purpose. Above this speed the price increases out of all proportion to the number of miles per hour gained. For instance, a twenty-five-mile boat may be built and equipped for less than two thousand dollars, but a craft capable of attaining thirty miles an hour would require the expenditure of at least twelve thousand dollars.

While the two-cycle marine motor is exceedingly efficient and reliable in the smaller powers, and is at all times less complicated than the four-cycle type, it is seldom found in the auto boat in horsepowers exceeding twenty. In horsepowers ranging from one-half to twenty, however, the two-cycle type will be found in every variety of boat, and it is in these smaller sizes that its greatest field of usefulness is found.

It is not the desire of the writer to be drawn into any discussion of the relative merits of these two leading forms of marine motors, and for the information of the novice it may be said, roughly, that the trend of design seems to favor the two-cycle type for the small powers, while the racers or heavy boats requiring large horsepower employ the four-cycle motor almost exclusively. In other words, a skiff or canoe should be equipped with the simpler two-cycle motor, while a large racer or ocean-going yacht needs the more economical and powerful four-cycle engine —and it is only where the fields overlap that there is any room for discussion between these powers.

While the graceful and swift-running auto boat may appeal to the sense of luxury in the average man, space and seaworthiness must be sacrificed for the attainment of high speed, and it is evident that this type of boat is not so well adapted to rough weather or extended trips as is the cruiser. Nearly all cruisers have the cockpit inclosed in a low cabin in which are sleeping and eating accommodations for from two to six persons—depending upon the size of the craft.

The cabin also contains a toilet room, lockers, and probably a couple of chairs and a writing desk, while deck space aft furnishes daytime accommodations for the crew or passengers. The high freeboard of the cabin and the inclosed cockpit make this an ideal rough-weather type of boat, and it is craft of this class which have successfully made the trip from New York to Bermuda.

A good-sized cruiser, when furnished with mahogany woodwork and equipped with an electric lighting plant, running water, and other modern conveniences, may become a veritable "floating palace," but such a craft is beyond the means of the ordinary man who desires to operate his own boat. But cruiser and costliness are not necessarily synonymous, for a twenty-five-boat of this type, with sleeping accommodations for three persons and driven by an eight horsepower motor may be purchased complete and ready for operation for eight hundred and fifty dollars, and so far as reliability and solid enjoyment of a cruise are concerned, it is fully the equal of its ten-thousand-dollar sister.

A type of motor craft exceedingly popular with those who desire to its fullest extent neither the speed of the auto boat nor the touring possibilities of the cruiser is the open boat with a canopy top and side curtains which may be closed down in case of rain or rough weather. This boat is by no means slow, however, for a thirty-foot hull of good model equipped with a fifteen or twenty horsepower motor can attain a speed of thirteen or fourteen miles an hour. On the other hand, while not possessing the advantages for living on board found in the cruiser, trips lasting several days may be taken in this type of open boat and a party of three or four may sleep in its roomy cockpit without great discomfort.

In such a boat the motor should be located amidships, and seats with lockers under them should extend around the rear half or two-thirds of the cockpit. This will leave space in the forward part for several comfortable chairs, while the lockers under the seats furnish room for nearly all necessary camping and boat supplies. If the hull is built with a V-transom stern a large space under the stern deck is left for stowing many of the more bulky articles which cannot be placed in the lockers. An extra steering wheel located near the motor enables the boat to be managed easily by one man.

When to the variety of styles and sizes of hulls which are or can be built are added the different types, powers, and makes of motors on the market, and when it is realized that almost any combination of use of the one with the other may be obtained, it will be seen that the choice of the motor boat purchaser as regards the details of his completed craft is by no means limited. Unlike the automobile, the engine in the motor boat may be replaced with a different one as often as desired, and the old motors reinstalled in other hulls. Continual changing of the power plant in a motor boat is not advisable, however, as the engine bed must necessarily be rebuilt for each different motor installed, and it is far better to select the engine best suited for the hull at first, and then use it until it is worn out.

The ease with which an engine may be installed in almost any kind of a hull has led to the practice in some places of converting almost anything that floats into a motor boat, and it is no uncommon sight to see catboat hulls, scows, and even flat-bottom punts chugging along under their own power.

It is probable that the owner of even the most expensive racer or cruiser will need a small "knockabout" for short trips in pleasant weather, and the inexperienced motor boat enthusiast cannot do better than to start his training with one of these inexpensive craft—for it will always be useful to him. From this he can graduate to a better and more commodious type of boat, if he desires, and at the end of a season or so of running his first purchase he will be in a position to know just exactly what he wants for its successor. But whatever size or class of boat he buys subsequently, it is almost certain that he will never find more solid enjoyment and unadulterated fun than he had the first season or two in his hundred-dollar "knockabout."

The most valuable boat of any of which I have heard belonged to a man who had a small farm on an island at one of the popular summer resorts in the eastern part of this country. This boat was not valuable so far as the price it would bring in the market, or the initial cost of it was concerned, for my friend did not pay over five hundred dollars for his twenty-five-footer, complete; its value lay in the service it rendered him and in the fact that it was indispensable to him both for business and pleasure. It was the "family sea-horse," ready to take him and his wife and children to market or to church at the near-by town, or to chug steadily up the river on a picnic or hunting trip.

From early spring till late fall the little boat was in use—and generally from morning till night. On the first day on which the river was opened for navigation in the spring, the craft would be launched and on its way to the nearest town, three miles distant, for the lumber and timber necessary to repair the portions of the boathouse and piers that had been damaged by the breaking up of the ice and the high waters of the spring freshets; then the next day down the river with a heavy scow in tow for a load of stones for the piers and sea wall; back before dark, and then over to town again for supplies or the mail, or to take the family to a dance or a "sociable"

—and the little craft would follow out a program similar to this for several weeks.

As the "season" opened and the boarders began to arrive, the boat served both as ferry and freighter, going over to the town to meet the trains and returning loaded with passengers; then back to town again for the trunks and baggage of the new arrivals.

Early in the morning this "Jack-of-all-trades boat" was at work, for my friend had a small garden and kept some of the neighboring cottagers supplied with fresh vegetables. Only for an hour, however, would it assume the role of market boat, for at the end of that time the fishermen would be waiting to be towed in their skiffs to the inlet where the bass were supposed to abound.

Did the boat loaf, during the day, while waiting to return for the fishermen or to meet the afternoon train? Only long enough for a few gallons of gasoline, for if the day was pleasant some of the ladies and children would be ready for their outing on the water—the boat was remarkable for its steadiness and the safety with which it could be loaded literally to the gunwales with human freight.

After the summer months were over and the boat had more than paid for itself in a single season, it was ready to serve as the pleasure craft for which it was first intended and to give its owner and his family several weeks of the enjoyment for which they had worked so hard. From passenger ferry, freighter, tug, mail packet, and vegetable boat, it became private yacht, fishing smack, hunting boat, cruiser, and on occasions even racer.

Or the little craft could tow the ungainly but comfortable house boat to another part of the river, and with the family living on board, a change of scenery and surroundings could be obtained which would serve as a vacation to these people whose whole summer had been spent in giving a vacation to others. This outing would be at a cost less than that of a railroad ticket to the nearest county fair.

And as a racer? Yes, indeed; there were other twenty-five-footers in the neighborhood equipped with approximately the same power, and a contest between these, or with others provided with suitable handicaps, furnished a race which, while of course not breaking any records in the matter of speed, was at least a close and exciting contest, and one more interesting to the little colony of natives than would be a race for an international cup between boats whose owners they were not able to call by their first names.

Now do you believe that this five-hundred-dollar boat was a more valuable little craft than one of ten times its cost? Of course the motor of this boat, during its few inactive moments, was not hitched to the churn and used to make butter, nor was it belted to the pump in order to keep the water-supply tank filled—these are only fairy tales of some visionary or press agent, and while possible of realization, are not practical—but as a boat it served in nearly every capacity imaginable and both worked and played for its master as well as though he had possessed a fleet of a dozen different craft.

Of course, not everyone who owns a cottage on some body of water suitable for motor boating can expect to get the range of use from a power craft that my friend did—nor would he desire to—but to a less extent a twenty-five-foot boat may be made the most valuable and important feature of a summer vacation. This will apply particularly to a section such as the Thousand Islands, on the St. Lawrence River, where one or more summer homes will be on an island completely isolated from the nearest post-office and source of supplies, and a boat of some kind is an absolute necessity.

Here it is as a means of communication with the outside world, of intercourse with the neighbors, and as a conveyance for all food that the motor boat stands foremost, and a cottager would no sooner think of being without a power craft of some kind than he would of going without shoes in winter. In the consideration of most of the vacationists here, the motor boat comes first, and the cottage, bungalow, or tent is of secondary importance.

If a man's business lies near enough to his summer home, or if he can get away from work for a week or so in the spring, he will find a stanch, twenty-five-foot boat, equipped with a gasoline motor of from six to ten horse-power, a money saver and of the greatest help imaginable in preparing his place for the summer. The high water and ice show no favors, and it is probable that the boathouse and piers of the cottager will need as many repairs as do those of the native—if not more, due to the lack of care throughout the winter in the case of the former.

In this connection, one of the best investments that can be made is the purchase of a flat-bottomed, square-ended scow on which almost any kind of freight can be carried. This can be towed by the little motor boat at a speed of four or five miles an hour, even when loaded with several tons of cargo, and will enable the craft to transport bulky articles larger than the hull itself, which would swamp it if loaded into the cockpit. This scow will probably be in almost constant use during the first part of the season, bringing lumber and stone for the repairs, household articles for the cottage, and coal and wood for the kitchen range and fireplace.

During the season, the trunks and baggage of the arriving and departing guests can be carried on the steady, flat-bottomed craft much more safely than would be the case were they trusted to the diminutive "hold" of the little motor boat, and in hundreds of ways the scow will save several times the thirty or forty dollars of its cost. If the motor boat is well finished inside, the saving in scratches and digs in the woodwork alone will more than repay the trouble in towing the scow for the purpose of returning with but one or two trunks.

Although not equipped with a steam scoop or like appliance, the little motor boat can make itself useful in the capacity of dredge, clearing away the submerged stumps or logs that will probably have drifted into shore or near the boathouse slip during the year. It should be made certain that all of these are removed at the beginning of each season, for a sunken log will damage a propeller or hull almost as easily as will a sharp rock.

It is really remarkable what a heavy load can be towed by a comparatively small boat. One of the most astonishing sights to the uninitiated is to see a small two-horsepower tender try to tow a yacht a hundred or more feet long. And it not only *tries*, but it *does* it—slow, to be sure, but steady, and with no more apparent effort on the part of the motor than if it was doing only its own work, and not that of three or four hundred horsepower as well.

One of the greatest pleasures to be obtained from a small motor boat is in preparing it for and entering it in a race with other craft of its class—a race in which the smooth and reliable operation of the motor and the efficient handling and jockeying by the navigator count for more than does the possession of excessively high power. The ideal race consists of a speed contest between boats of exactly the same design of hull and driven by the same kind and size of motor. This enables each contestant to start on even terms with all the others, and even though the maximum speed should not be more than ten or twelve miles an hour, a close and exciting finish may be expected and the winner will have deserved his success on his own merits.

It is hardly probable that at one summer resort there would be a sufficient number of boats of the same design to enable a race of this kind to take place, unless several were built for the purpose of holding such contests. In the latter case, however, they would have been built for the purpose of racing and would be *racing boats*, and as such they could not be included with the combination work and pleasure boats with which we are dealing.

A scarcity of boats of the same design need not prevent interesting races from taking place, providing a system of handicapping the faster craft has been devised. A handicap on a boat is, at its best, a very arbitrary arrangement, and the dissatisfaction expressed with the old-fashioned "ratings" finally became so pronounced that they have been done away with to a large extent in national and international races.

In the small amateur races, however, in which the contestants enter their boats for the fun they can get out of the event, some plan must be adopted whereby all entrants will be placed on an even footing. Measurements, cylinder volumes, midship sections, and the like cause so much dissatisfaction as a basis for handicaps that it is probable that the only fair method is the "time trial" system. By this method each entrant makes a round of the course under, supposedly, racing conditions, and the time that his boat makes is used as a basis upon which his handicap is figured.

Although there is nothing to indicate that the owner has been making his motor do its best work on this time trial, the figures are accepted as handed in, without question or examination. To provide against any deception, intentional or accidental, any boat completing the course in the race in a time which is more than three per cent. under that used as a basis for its handicap, will be disqualified.

The summer program of the average cottager seems nowadays to include a trip or cruise of some kind for a few days to another part of the body of water on which he is spending his vacation. This is a feature of a vacation which has been made possible only by the development of the motor boat and its low cost that places it within the reach of everyone. Of course if it is desired to live aboard the boat for any length of time, a cruiser equipped with berths, a galley or kitchen, and some of the other "comforts of home" is necessary, but for short trips of not over a week or so in duration, our little friend, the twenty-five-foot open boat, may be made to serve the purpose admirably—and here we see it in still another role.

It is not, however, until the vacationist adds houseboating to his list of summer recreations that the full value of an all-round motor boat will be realized. It is then that the advantage of a strong motor installed in a substantial hull will be seen, for a ten or twelve horsepower engine in a twenty-five-foot boat can tow a five- or six-room house boat considerably faster than a man can walk, and yet, when released from its burden after the destination is reached, the little craft is not so large but that it can serve as messenger, "runabout," and sight-seeing boat and act as connecting link between the house boat and a base of supplies. Its draft will be small enough to allow it to navigate shallow streams and explore bays and inlets, and yet the hull will be of sufficient size to enable it to outride safely all but the severest storms.

It seems that the average "pleasure-work-boat" of the kind that did such good and profitable service for my friend who ran the summer boarding house is the type best suited to the average man, and whether he is able to afford but one or a dozen motor boats, such a craft is well-nigh indispensable to the vacationist who spends his summers on a lake or river. It will work for him and play for him; it will help make repairs to his place; it will carry wood and coal and the baggage of his guests; it will act as tug and racer

—and may win a cup for him as a result of a well-deserved triumph; it will take him and his friends to far-distant fishing grounds; it will supply him with mail and provisions; it will furnish him with a change of air, scenery, and surroundings on a day's or a week's cruise; and, in fact, it will increase the possibilities and pleasures of a vacation several times over.

And what does it ask in return? Nothing, if it is a well-behaved boat, except that it be fed with gasoline and oil and used with common sense. And then, if allowed to hibernate in peace throughout the winter, protected from the ice and damp, stagnant air, it will be ready for another strenuous season after only a few days' grooming in the spring.

## CHAPTER II

### WHEN THE MOTOR BALKS

TO quote an oft repeated phrase from the closing words of a lecture given by a well known college professor, "When your motor refuses to run you may be reasonably sure that the trouble is due to one of three causes: first, a stoppage in or poor adjustment of the carburetor; second, the failure of the ignition system; and last but not least, 'pure cussedness.'" Anyone who has cranked and cranked a balky motor until his back is nearly broken will heartily concur and will give the devil more than his due by bestowing full credit for all troubles of this nature upon the last-named reason.

But the modern marine motor is not the cranky little piece of mechanism that many of its defamers would have us believe, and although up to a few years ago it had not attained the perfection of design and performance reached by its more expensive cousin in the automobile, the gasoline engine found on the water to-day is a well constructed and satisfactory machine that does its work and stops only when there is a good reason for it. Of course there are many old and ramshackle motors of a decade ago installed in various hulls of an equally nondescript type, and the combination of the two may form the craft which has done much to bring the gasoline marine engine into disrepute in the minds of those who know nothing of the matter, but such freaks should not be taken as criteria by which to condemn all other self-propelled boats without a careful examination.

Perhaps as much time and thought have not been put upon the design and construction of the marine motor as have been bestowed upon the automobile engine, but if this is the case, it is because conditions upon the water do not call for extreme light weight, the use of the same water over and over again for the cooling system, or a machine that will withstand the shaking jolts and jars that fall to the lot of a motor car power plant. A motor which will give satisfactory service for years when installed in a boat might hardly serve to drive an automobile a mile over a level road.

On the other hand, however, automobile engines are in use in many motor boats and give very satisfactory service after slight changes have been made in the cooling system and attention given to a few other minor details which would not interest the lay reader.

It will be understood from this, then, that anyone who is an experienced motor car driver should have no difficulty in operating a marine engine—unless its very simplicity and absence of complicated parts should confuse him—and the same trouble may be looked for in one as in the other. For every trouble there's a reason and a remedy, and even the "pure cussedness" may be cured when one understands his motor. Some motors seem almost human, and two of the same make and model may require to be handled so differently that it is difficult to realize that they are the products of the same factory.

Much of the marine-motor contrariness may be laid at the door, or needle valve, rather, of the carburetor. This, as nearly everyone knows, is the chamber and series of valves where the gasoline is vaporized and mixed with the air in the proper proportion to be exploded in the engine cylinder. The amount of air used in this mixture is about twelve times greater than the gasoline vapor, and a small variation in this proportion will give the "too weak" or "too rich" mixture, with consequent poor running of the motor.

The needle valve admits the gasoline in the form of a fine spray into the chamber in which it is mixed with the air and a slight turn in either direction will greatly vary the proportion of the resulting mixture. Some carburetors are automatic, and when once the needle valve is set, deliver the proper mixture to the cylinder for all speeds of the engine.

But there is no carburetor made that can control atmospheric changes; and heat, cold, or dampness in the air will have such an effect on the resulting mixture that while the engine may have been running perfectly on a certain day with the needle valve set at a particular notch, the conditions of the next day may require a quarter of a turn change in the needle valve position before the proper mixture is obtained. It is for such troubles as these that the motor itself is blamed.

All this would seem to imply that the third reason given by the college professor for trouble in the gasoline engine was the same as his first reason. But trouble may be caused by a well defined defect or poor adjustment of the carburetor. When this is the case it should not be confounded with the elusive changes in atmospheric conditions and other indefinable reasons which are classed as "pure cussedness."

If a motor stops unexpectedly, much time will be saved by knowing just where to look for the trouble, and the experienced engineer will bring several of his senses into use in locating this. The manner in which a motor stops is often indicative of the nature of the trouble. For instance, if your motor is spinning merrily along and then stops abruptly without warning, it is pretty certain that one of the electrical connections on batteries, switch, coil, engine, or timer has become loosened or broken and it will pay you to examine thoroughly each one of these terminals before devoting your attention to other parts of the mechanism.

A failing gasoline supply, on the other hand, will be indicated by a gradual reduction of power in the motor, the impulses growing weaker and weaker until the engine stops. Pitted platinum contact points of the vibrator which cause the coil to "stick" and batteries which have nearly run out will be evidenced by the same symptom—a peculiar hitch or catch of the motor which can be felt in the whole boat, after which the engine may run smoothly for several minutes. These hitches will increase in frequency until the motor stops, unless the cause is properly attended to at once.

Coil or battery trouble is one of the most elusive with which the motor boatman has to contend, for after removing the plug and turning over the wheel until connection is made, he is liable to be deceived by the generous spark exhibited and by the satisfactory buzz of the vibrator. This is due to the fact that failing batteries or a sticking coil will not exhibit their weaknesses except at intervals and conditions are much better for the production of a spark in the open air than in the high pressure of the engine cylinder. For this reason it is always a good idea to include a small battery tester as a part of the regular equipment of the boat and keep yourself well informed as to the condition of the source of your ignition current.

If the batteries are found to be in good condition—that is, delivering six or eight amperes of current or better—and the spark plug delivers a good, fat, violet-colored flame, it is evident that the ignition trouble must lie in the coil. In this case a bit of fine emery paper should be run over the platinum points of the vibrator and set screw and the motor turned until contact is made through the timer.

The buzz of the coil should be well defined and should not change pitch during the connection. If the pitch does change, however, it is evident that the adjustment of the vibrator is wrong and the set screw should be turned in one direction or the other until the sound that you have been accustomed to hear is given off.

A single miss of the motor should not always be taken as an indication that the batteries are weak or that the coil requires attention, for the trouble might be caused by a fouled spark plug due to an excessive amount of lubricating oil on the cylinder walls. If missing from this source continues, the spark plug should be removed and the electrodes, or points between which the spark jumps, cleansed with fine emery cloth and the carbon deposit softened by the application of a small quantity of kerosene.

This occasional miss of the motor was once the cause of an amusing experience which befell a party cruising through a canal in a motor boat. The boat was gliding peacefully along between overhanging banks and the occupants were enjoying the scenery, when suddenly, with no perceptible change of sound in the motor, it was noticed that the shores on either side seemed to be moving in the other direction. Then it was found that the boat was moving backward as unconcernedly as she had formerly been running forward and only the most active work on the part of the engineer prevented her from ramming, stern foremost, into the nearest bank.

The cause was as simple as the results were amusing. The motor was of the two-cycle type which will run as well in one direction as in the other. When all gasoline motors are running at maximum speed the spark is advanced so that the explosion occurs before the piston reaches the top of the stroke. A small carbon deposit had accumulated on the spark plug and this caused a cessation of the explosions for one or two turns before it was burned off. When the spark resumed work the momentum of the engine had died down sufficiently to allow the next explosion to turn the fly wheel in the opposite direction, and it continued to revolve in that manner. This had been done so quickly that the occupants of the boat, engrossed with the scenery, had not noticed the slight pause in the engine, and when the motor had once started reversing, no difference could be detected in the sound.

This same principle is often made use of in engines of this type to cause them to reverse, but in this case, the switch is thrown off until the speed of the motor is reduced enough to allow the next impulse, occurring before the piston reaches the top of the stroke, to take the fly wheel over in the opposite direction. The above incident is only one of the many which might be laid to "pure cussedness" by the amateur who is not thoroughly acquainted with all parts of his engine, and yet a very definite and specific reason existed.

It is probable that hearing plays a greater part in first locating the source of trouble in a gasoline engine than any other of the senses, and the expert can tell by the sound of his motor whether it is receiving too much or too little gasoline, too much or too little lubricating oil, or if the difficulty lies in the ignition system. An excessive supply of gasoline in the mixture will cause a series of weak explosions which will slow down the motor and result in irregular running.

This is because there is not sufficient oxygen in the mixture to support the combustion of the gasoline vapor, and the trouble may be remedied by increasing the amount of air or decreasing the flow of fuel to the carburetor. Most carburetors, however, are so constructed that the gasoline flow is regulated and a very slight turn of the needle valve to the right as you face it should help to give the proper mixture. Many marine motors require a richer mixture for starting than they do after attaining full speed, and consequently the needle valve is used when it is desired to vary the speed of the engine.

When the mixture is weak, meaning that it contains an insufficient supply of gasoline for the accompanying amount of air, a crank case, or base, explosion will generally be the result in a two-cycle, three-port motor. When these explosions are once heard there can be no mistaking them afterwards, for the short, sharp crack, followed by a puff of smoke from the base of the motor causes the uninitiated to feel decidedly apprehensive.

There is no real danger, however, and these crank-case explosions are to be expected nearly every time the motor is slowed down without opening the needle valve a sufficient amount. With motors not equipped with delicate carburetors it is a good idea to open the needle valve about a quarter of a turn before retarding the spark, thus supplying a sufficiently rich mixture for the reduced speed of the motor. If this is done the needle valve will be set at the right point when it is again desired to start the motor.

The most economical and efficient running is obtained when the needle valve is set so that the motor receives as little gasoline as possible without the attendant base explosions. The reverse clutch should not be thrown in or the propeller blades turned when the base explosions are frequent, for the extra load on the motor at a time when the impulses are irregular is liable to "stall" the engine, and if the reverse is depended upon for checking the headway of the boat in making a landing, a smashed bow is liable to be the result.

These differences in the sound of the running of the motor are caused by a change in the nature of the explosions or in the frequency of the impulses. Sounds foreign to the explosions, however, may indicate trouble in the motor; above all, the operator should beware of the fatal click which indicates a loosened connecting rod or a stray nut or bolt in the crank case. If the motor is not stopped immediately when these conditions arise, a broken connecting rod or crank is almost certain to be the result. Fortunately, however, such accidents seldom happen, although the engineer may receive a good scare through mistaking a slight pound or knock in the cylinder head for the click of an obstruction in the crank case or a loose connecting rod.

A decided pound in the cylinder head soon after starting the motor may be caused by advancing the spark beyond the point at which it is intended to be set, thus igniting the mixture before the piston is sufficiently high on the stroke. A man who has run a certain boat a few times will soon learn the point at which the spark lever should be set for the proper operation of the motor, and it will then become second nature to him never to advance the spark beyond this point.

With the spark set in the proper position a knock in the cylinder head can generally mean but one thing—a hot engine caused either by a stoppage in the water cooling system or an insufficient supply of oil to the piston. In nine cases out of ten the latter will be the cause of the trouble, and if you will look at your sight feeds you will probably either find that the glasses are full, indicating a stoppage in the feed pipe, or that you forgot to open the cups or possibly fill the oil tanks.

Continued running with an insufficient supply of oil will soon cause the piston to expand with the heat so that it will seize the cylinder walls with a grip that cannot be loosened until the metal has cooled. When the cylinder overheats a small quantity of kerosene should be poured into it through the spark plug opening and the fly-wheel moved back and forth as the cylinder and piston gradually cool until there is a perfect freedom of motion between the two.

A liberal amount of lubricating oil should then be added and the motor revolved by hand power until the cylinder walls are thoroughly lubricated. Do not expect, however, that your motor will run as well after an accident of this kind, for the immense amount of friction set up between the piston rings and the cylinder walls will score or grind one or the other until a slight leakage of compression may be the result.

The sense of smell will often enable the man who is well acquainted with his motor to detect an insufficient supply of oil in the cylinder or stoppage in the cooling system. When the engine becomes overheated from either of these causes a peculiar choking, pungent odor will be given off which should be taken as an indication that the lubricating or cooling systems require immediate attention.

Too much lubricating oil is far better than too little, and yet the former may be the cause of very annoying trouble in starting the motor. The excess of oil is bound to become burned in the cylinder and the smoke thus formed may choke the explosion to a certain extent, or may form a carbon deposit on the spark plug, as already described, which will prevent ignition for a few revolutions.

Trouble caused by too much oil can seldom be mistaken, for it is always indicated by clouds of blue smoke which pour from every opening in the motor with each explosion. With the simple form of marine-motor now equipped with a mechanical oiler, the relief cocks should be opened occasionally to make certain that there is at least a faint trace of blue smoke given off with each explosion; the operator may then rest assured that the piston is receiving a sufficient amount of oil.

All things considered, it is probable that the ignition system is responsible for a greater share of trouble in the marine-motor than any other part of the machine, and too much attention cannot be given to it. The greatest enemy to the high-tension ignition system, or jump spark, is water, and the open boat equipped with this type must be well protected from rain or spray if it is to be run in all kinds of weather.

Dampness will weaken a set of batteries almost as quickly as a closed circuit, and the box in which these are contained should be made either water-proof or placed in a part of the boat where the water cannot possibly reach it. The coil, too, should be kept dry, and if convenient, it should be placed in the same box in which the batteries are kept. But even after protecting these parts of the ignition system from the wet, the motor cannot be relied upon to run continuously unless the spark plug and all bare terminals of the high-tension wires are covered, for the slightest dampness will short circuit the plug and cause the spark to jump from the wire to some part of the motor, instead of across the gap at the end of the plug in the cylinder, as should be the case.

If your boat is caught in a storm with insufficient protection for the motor, the spark plug may be kept dry by placing an oilskin hat over the top of the cylinder, and if the high-tension wires are covered with heavy insulation, you may be able to get home without a miss from the motor. It is a good idea to cover the insulation of the high-tension wires that are exposed with several coats of shellac to render them thoroughly waterproof, and also to prevent the disintegration of the covering by any gasoline or oil which may come in contact with it.

If in addition to the above precautions, extra spark plugs, additional batteries, and a spare platinum contact point and vibrator for the coil are carried along, you should be ready for almost any emergency that may arise to put your ignition system out of commission. Add to these extra cans of gasoline and lubricating oil—about three times as much as you know you will need—and you will be ready, so far as your motor is concerned, to start on a trip of almost any length. Of course, a full outfit of tools should always be in a convenient place in the boat.

When your motor stops unexpectedly, don't get excited, but start in calmly to trace out the cause of the trouble. Take your time, and even though there may be an impatient crowd on board, don't appear to hurry. If the wind or tide is carrying the boat toward the shore, throw out the anchor rather than feel that you have but a limited time in which to discover the trouble and make the repairs.

Trace the trouble logically by a process of elimination, and if you are unable to tell instantly from the manner in which the motor stopped just what was the cause, ascertain, first, that nobody has kicked off the switch; second, that there is a good healthy buzz or click heard from your coil when the cover is removed and the fly-wheel turned to an electrical contact; third, that there is plenty of gasoline in your tank, and fourth, that gasoline will drip from the carburetor when it is flushed by depressing the float in the chamber.

If you are not able to locate the trouble by this time, remove the spark plug and make certain that there is a fat, violet-colored flame passing between the proper terminals when the contact is made and the large nut of the plug is laid on some part of the engine. This is important because a healthy sound from the coil does not necessarily indicate that a spark is being delivered from the plug. The coil will buzz when the current is delivered to it, irrespective of what becomes of the transformed electricity afterwards.

Reason it out this way: If the gasoline reaches the carburetor and is there united with the proper quantity of air, an explosive mixture must reach the top of the cylinder—unless the rings are too badly worn or the packing at the base has blown out. Once in the cylinder, the mixture must explode if a hot spark is delivered at the proper moment, and when this occurs, the piston will be forced down and the flywheel will turn if the bearings or piston have not become heated and stick through lack of oil.

These may seem like enough "ifs" to cover a multitude of sins, but each of the little monosyllables may be turned into a positive or negative certainty by a few moments of the right kind of work. If, however, you think you find that all the "ifs" are certainties of the right kind, and still your motor doesn't run, you may then lay the trouble to "pure cussedness"—until a man comes along who knows the least bit more than you and shows you a simple thing that you had overlooked. Then you will agree with the writer that "there's always a reason"—and generally a very simple one, at that.

## CHAPTER III

### SPEEDING UP THE MOTOR BOAT

THE question of speed in a motor boat is an intricate one, as there are many factors to be considered; and these do not always give the results that are expected. A fleet of boats may be built, all of exactly the same size, constructed from the same patterns and equipped with the same make and size of motor, and yet there may be a consistent difference of from ten to twenty per cent. between the speed of the fastest and slowest. It is such results as these, consistent by virtue of their inconsistency, that puzzle not only the owner, but the designer and builder as well; and it is safe to say that not a single one of the most expert of the latter can accurately determine what speed a motor boat will make until she is actually launched and tried out under the best of running conditions.

If the expected results are not then obtained, it may require no small amount of experimenting before the real difficulty is found; when it is believed that an increase in power will produce the desired speed, it may be discovered that this will not be nearly so effective as a simple change in the pitch of the wheel. It is small wonder, then, that both expert and amateur will be found making frequent changes in the details of his boat in search of that elusive extra mile-an-hour that he so much desires.

The power plant will probably receive more than its share of praise or censure, according to the performance of the boat, and it is to this that the ordinary owner will first direct his attention if any increase in speed is desired. The greater the speed desired, the more powerful must be the motor installed to drive the boat. But it must be remembered that by power is meant the actual ability to do work, and not necessarily the size of the motor or bore and stroke of the cylinders. The old-style motors of ten horsepower were much larger and more clumsy than the present-day engines developing over twice that power, and while, under the same conditions, a greater bore and stroke will give an increased power, it is the actual test of the motor on the blocks that really counts.

But a more powerful motor is not an Aladdin's lamp that may merely be rubbed with the starting crank to shoot the boat off at a greatly increased speed. There are, in fact, certain limits beyond which a boat may not be driven, no matter how great the power installed, and this applies to the motor canoe and converted cat boat as well as to the especially designed racer. The tendency to "overpower" is one of the great faults of the average amateur and of many builders; every design has a certain speed beyond which any increase in number of cylinders or size of motor is an actual waste of power.

An incident illustrating the futility of crowding excess power into a hull that is already being driven at the top speed for which it was designed is found in the case of one of the well-known racers of a few years ago. This particular craft was thirty feet long, and when equipped with a forty-eight horsepower motor, could maintain an average of twenty-four miles an hour—a speed considered remarkable in those days. But her owner was not satisfied and decided that if he could get twenty-four miles with forty-eight horsepower, he would have no trouble in making a world-renowned racer if a one hundred and fifty horsepower motor was installed in her.

He made the change, but instead of being able to travel over the water at the rate of thirty-five miles an hour, as he expected, he found that his craft could make scarcely a mile an hour more than she could with her old motor, and that the greater part of the increased power only served to drive her *into* the water, instead of *over* it. When the motor was opened to its full power, the hull almost submerged itself in its own wave, and it was found that the fastest running was obtained when only about one-third of the available power of the engine was used.

This, of course, was an extreme case of ignorance on the part of owner and builder (or rebuilder, rather), but results of this nature are liable to be obtained, to a less extent, when applied to smaller boats of low power and slow speed. "Let well enough alone" is a good maxim to follow, although this does not mean that better results cannot be obtained often by increasing the power of a motor boat. Many hulls are not equipped with an engine sufficiently large to obtain the speed for which the craft was designed.

Even in this case it will require a greater amount of additional power than the owner will probably deem necessary, for the resistance to the passage of a boat through the water may be said, in general, to increase as the square of the speed, and the power necessary to obtain a greater speed has been found to vary as the cube of that speed. This, perhaps, is a sufficient reason why the power in a certain hull may be doubled with an attendant increase in speed of but one or two miles.

On the other hand, even though the increased power necessary seems out of all proportion to the results obtained, this is not necessarily all lost. Take, for instance, the case of a heavy, thirty-foot pleasure boat, constructed more for service and comfort than for speed. A twelve horsepower motor may drive this craft at eight miles an hour, and yet double this power would scarcely serve to shove the heavy boat through the water a mile an hour faster. But while this added power would not exhibit its presence by a noticeable increase in the speed of the boat, other craft could be taken in tow with no apparent reduction in the original eight or nine-mile speed of the tug boat.

The power plant of a boat can be increased or reduced to suit the desires of the owner, but once the shape and size of the hull have been decided upon, changes of this nature are not easily made. Consequently, the "lines" of the boat become really of foremost importance in a consideration of speed. The best designed hull for any practical purpose is that which is sufficiently large and heavy to carry the load intended for it, is seaworthy, and yet one that will travel over the water and will make as little wave and disturbance as possible. A boat which "pulls the whole river behind her" is either overpowered and is being forced through the water at an uneconomical speed, or she is poorly designed and her lines offer a greater resistance than should be the case.

Although many boats are designed to "draw down" at the stern when under way, this characteristic should not be carried too far, as an undue drag is then formed by the after half of the hull. The once popular canoe model of speed boat gave way to the torpedo stern, and this, in turn, has been replaced by the moderately wide hull with the "V-transom" stern, a design well adapted for almost any purpose, from a small, one-man "runabout" to a racer or a large cruiser. This model rises slightly at the bow at the higher speeds, but the under side of the stern is flattened so that the submerged portion is pushed over the *surface* of the water, rather than through it.

This is the principle applied to the hydroplane, except that the under side of this model is shaped in a series of steps slanting from stern to bow so that, as the speed increases, these successive steps, or planes, will rise out of the water and the hull will finally be riding on a single surface that will glide, or slide, with much less attendant resistance than would be the case were the entire hull forced through the water. Other variations may be applied to the design of the hydroplane, but all are developed on the theory that a hull that skims over the water meets with less resistance than does one that must move aside a great amount of water in order to push its way through.

If a hull does not seem capable of attaining the speed expected of it, the impulse of many a builder seems to be to "cut her in two and add five or six feet to her length." Although this will be a time-consuming operation, it will be effective to a certain extent, for the speed of a boat increases with its waterline length. On the other hand, the greater the beam of a boat, the slower will be its maximum speed.

The observation of these two rules will result in the conclusion that a hull that is "stubby and square" will never succeed in landing a racing trophy if it is competing with a long, slim craft. But craft of "toothpick" proportions are unstable and unseaworthy and can be of no possible interest to the man looking for a practical boat that will combine utility and speed in the proper degree. For pleasure craft of from twenty to forty feet in length, a beam of from one-fifth to one-sixth this measurement is a good proportion which will admit of both stability and medium speed.

An increased speed may sometimes be obtained from a motor boat by making changes other than those in size of engine or design of hull, and these are the refinements that help make the average pleasure boat of to-day from two to five miles faster than its sister of a few years ago. It has already been pointed out that the bow of a boat should not rise from the water more than a certain amount when it is under way, and that the V-shaped transom was designed to keep the proper length of the hull under the water. But the tendency of all hulls when traveling at normal speed or above is for the stern to settle an undue amount, and in the case of old style boats with the fan-tail stern and such craft as the converted cat boat the shape of the after section does not prevent this undesirable dragging and consequent reduction in speed.

This trouble can be easily remedied, however, by simply attaching a piece of sheet iron to the stern at the waterline so that it will act as a plane when the after portion of the hull tends to drag down. This piece of sheet iron should be cut the same shape as the stern deck so that no portion of it will project too far beyond the hull and be damaged by a wharf or rock, and it should be well supported by struts riveted to the iron at one end and screwed into the planking at the other.

The value of such an attachment has been demonstrated many times, but in no instance of my personal knowledge more strikingly than in the case of an old twenty-five foot cat boat equipped with a twelve horsepower motor. When first installed, this motor seemed to be too powerful for the craft, the stern dragged down, and eight miles an hour was the highest speed that could be obtained. A sheet iron plane was attached in the manner described above, and by forcing the hull to travel on the lines for which it was designed, the speed, with the same power plant, was increased to eleven miles an hour.

Changing the location of the motor will sometimes have the effect of obtaining a slight increase in the speed of a boat, particularly if the stern is found to draw down too much. A speedy boat will never be found with the motor located in the extreme stern, and the majority of racing boats have their power plant placed in a compartment well forward. Consequently, by moving a heavy motor from the stern to the bow, the position at which the boat travels will be changed on account of the shifted weight, and in many instances the speed will be noticeably increased.

When an owner has made all changes imaginable in his boat in the endeavor to obtain more speed; when he has enlarged the power plant; when he has refined the lines of the hull until it seems to run with scarcely a ripple; when he has tuned up his engine; when he has smoothed and scraped the planking and given it its coat of friction-reducing paint, there always remain the possible surprises to be found by putting on a new propeller. This is not a complicated or difficult operation, and yet sometimes it may be the most productive of results of any change imaginable.

The propeller, of course, does the actual work of driving the boat through the water and any fault in its design or unsuitability for that particular hull or motor will result in an absolute waste of power. It also acts as the regulator of the number of revolutions at which the motor will run when "opened wide," and as there is a certain normal speed at which any engine will operate at the highest efficiency, the size and pitch of the propeller play an important part in obtaining the best results from the power plant that is being used.

The propeller blades are really the development of a screw, and the pitch would correspond to the coarseness of the threads. The pitch of a propeller, however, is measured in inches, and is considered as the distance a point on the blade would travel in a line parallel to the shaft during one complete revolution of the wheel. In other words, the pitch is the distance that the propeller itself would travel during one revolution, in a line extending along its axis, if the movement were made in a medium in which there is no "give," or slip.

The greater the pitch of a propeller, then, the greater will be the resistance offered to its turning; but, within certain limits, if this increased resistance is overcome, the boat will be shoved a greater distance through the water at each revolution. Consequently, "easy" pitch and high revolutions would produce the same results as "heavy" pitch and slower speed of rotation—always within certain limits. The longer and wider the blade of a propeller, the greater will be the resistance to its revolution. The increased blade surface, however, will exert a greater thrust upon the hull with each revolution, and consequently a large wheel is "faster," for the same number of turns, than a small one.

There are four things to be considered, then, in connection with a propeller, as follows: Size, or diameter of the wheel; shape of the blades; pitch; and number of blades. The first and third of these considerations are regulated by the normal speed at which the motor will operate at its highest efficiency, always remembering that a wheel with too much pitch will work against itself and absorb power from the motor without delivering a corresponding increase in the speed of the boat.

The problem of "too much pitch" will be better understood if it is remembered that "infinite pitch" would be represented by a wheel the blades of which were set at right angles to the plane of revolution, or parallel to the axis. The revolution of such a wheel would absorb power with no resultant motion in either forward or reverse direction.

Three-bladed propellers are used on the majority of motor boats, so this is a problem that need not give the owner much concern.

For motors under three horse-power, however, it is advisable to use a wheel having but two blades, as any greater number would necessitate the construction of so small a propeller that efficient results could not be obtained without reducing the pitch to a very small degree. It is in the shape of the blades, then, that the greatest latitude of selection will be found, and here is ample opportunity for the trial of all manner of wheels.

Whether the blade should be long and tapering, thin at the hub and thick at the end, or of uniform width throughout the greater part of its length, is largely a matter of opinion; a certain shaped propeller that will give excellent results with one boat would be utterly unsuited to a craft of different proportions and character, even though the proper size of wheel should be selected. But, provided a well-designed wheel can be obtained, of approximately the proper pitch and of such a diameter that the motor will be held to its normal revolutions, the owner need not worry as to what results could be obtained with a different propeller, for, except in the case of racing boats, it is not probable that any change would make a difference of more than five per cent in the speed of the craft.

Every propeller should be so placed that its entire periphery will at all times revolve well below the surface of the water. This is necessary in order that the propeller may have a solid body of water against which to exert its push. Unless this distance is at least six inches, in wheels of sixteen inches in diameter, and over, a vigorous whirlpool, or eddy, will be formed that will reduce the efficiency of the blades as they revolve past this point of disturbance.

Another reason for placing the propeller rather well below the surface of the water will be seen on a rough day when, if the wheel is not properly located, it will be uncovered with every wave and so reduce the resistance on the motor that the latter will be allowed to race at each forward lunge of the boat. This tendency will be overcome if the wheel is placed several feet forward of the extreme stern of the hull, but as high a speed or efficiency will not be obtained in this position as would be the case were the propeller located as far aft as possible.

When a boat is tested out for speed, the trial should always be made in a comparatively large body of water, for the full efficiency cannot be obtained in shallow or narrow streams on account of the drag of the following waves on the bottom or shores of the waterway. Even the fastest racer would not be able to travel more than ten or twelve miles an hour through a narrow canal, and at this speed it would "pull the whole river behind it."

Owing to the greater buoyancy of salt water, the speed of a boat in this medium is generally considered to be greater than that on inland lakes and rivers. This is true to a certain extent, but the difference is usually over-estimated, for it has been found by tests that the respective speeds are as 5.66 is to 5.5—an almost negligible proportion except in exceedingly fast racers.

The foregoing discussion regarding speed in motor boats is not intended to make any owner dissatisfied with the present performance of his craft, for that would be to sow the seeds of discontent. But there are many boats in use that, with a little refinement or change in equipment, will travel faster with the same expenditure of power, and if these details are attended to, a more efficient, as well as a more economical craft will be the result.

# CHAPTER IV

## GETTING MORE POWER FROM A NEW MOTOR

LET the motor boatman not be deceived for a moment into thinking that we are about to divulge some secret formula whereby he may increase the power developed by his engine and thereby surprise his friends with two or three miles an hour added to the speed of his craft. Such formulas do not exist, and while some speed maniacs may recommend "dope" in the fuel tank, the addition of any stimulant is almost certain eventually to result in a weakened motor. The power developed by a motor that is in perfect condition cannot be increased, and it is wasted time to labor with an engine that is doing its best. The gasoline motor is not like the steam engine, the power of which can be increased by added steam pressure, and its limitations are sharply defined by its bore, stroke, compression and efficiency of its joints, packing, air passages, and bearings.

This would seem to indicate that a new motor offers no opportunity for improvement except during the first few weeks of running required to "wear it in" and increase the efficiency of the moving parts and that no attention will be required by it until the time for the first spring overhauling. This should be true, and every man who has spent time, thought, and money on the selection and purchase of a new motor has the right to expect that all adjustments have been made and all faults remedied at the factory and that his acquisition will develop its maximum power and run at its highest efficiency from the outset.

No factory is absolutely infallible, however, and even though the motor may have been in perfect condition when it was shipped, the knocks and jars of transportation, loading and unloading may loosen some of the parts or shake them out of adjustment. Added to this, the amateur may make some mistakes at the outset when trying to start his new motor, and even though the results of these mistakes may not be apparent for some time, they may contribute to a decided decrease in the power of the machine. Then, too, a poor quality of cylinder oil may have been used which has become gummed during the long interval between the final factory test of the motor and its trial by its new owner; and dozens of other troubles and accidents may contribute to the poor performance of a power plant from which great feats have been expected—and can be obtained when the seat of the disturbance is reached and matters remedied.

Assuming that the motor runs, let us suppose that it does not develop the power for which it was designed. With good gasoline and a "fat" spark, this loss of power nine times out of ten will be due to faulty compression. Power cannot be obtained without sufficient compression in the cylinder, for it is upon this that the force of the explosion depends and a leak allows this useful energy to escape and be wasted absolutely. The compression, of course, can be felt by the resistance offered to turning the flywheel when all valves and cocks in the cylinder are closed. If there is more than a single cylinder, the one offering the least resistance is certain to be that in which the trouble will be found, for under normal conditions the compression should be the same in all on the up-stroke of the piston.

If the motor has but one cylinder, its compression-retaining ability may be determined by turning the flywheel until the point of greatest resistance is reached and then holding it there until it can be moved past the "dead center" easily. If the motor possesses good compressison an appreciable time will elapse before the resistance is reduced sufficiently to enable the flywheel to be turned over, but it must be remembered that even in the best of engines the compression will escape eventually. But if the flywheel may be turned over slowly without meeting any vigorous resistance, it may be safely assumed that good compression is a negligible quantity in this case and the leak should be sought.

The average compression in an ordinary gasoline engine is about sixty pounds per square inch, which would amount, in a four-inch cylinder, to a total resistance of about 750 pounds. But if the flywheel by which the piston is moved is two feet in diameter and if the crank is two inches long (assuming a four-inch stroke), the actual force necessary to be applied at the rim of the flywheel would be but 125 pounds; and if momentum has been attained by giving the flywheel a swing, this resistance can be overcome comparatively easily and the force of compression will not be found to be as formidable as the figures would have it appear. But by keeping the comparative values of these figures in mind and remembering that even the strongest compression will gradually escape past the piston rings if the piston is held near the top of its stroke, even the rankest amateur can learn to disinguish between good and poor compression.

It is to the piston rings that most of the loss of compression can be laid. These rings are supposed to form a tight joint between the cylinder walls and piston, for the latter, having to move freely and being subject to variable expansion due to the heat, cannot be machined to a perfect fit. The rings, on the other hand, being springy, can adapt themselves to any temperature that will be found within the cylinder walls—provided they receive sufficient lubrication.

The majority of motors are tested after manufacture and are shipped to the purchaser with the piston and rings thoroughly oiled and a certain amount of lubricant in the base. In the case of a new machine, however, the moving parts of which are liable to be "stiff" at first, it is better to be on the safe side and introduce plenty of fresh oil into the crank case and to the piston and rings before the motor is started.

But in spite of these precautions, one of the rings may have become "stuck" in its groove so that it no longer automatically fits the curvature of the cylinder walls and consequently the compression and the exhaust gases of the explosion are allowed to escape past it. There will probably be three or four rings on each piston and the motor may run with the remainder of these in working condition, but the best results cannot be obtained unless all are loose in their grooves. Consequently it is for a stuck ring that the owner is to search first when he finds that one cylinder fails to holds its compression as well as its companions.

The only certain way of locating and remedying the trouble is to "get at" the rings. In the case of a motor having a solid cylinder head, this may be done by removing the entire cylinder casting from the base of the machine, thus leaving the piston and rings exposed. If the motor has a removable head the connecting rod may be loosened from the crankshaft by reaching through the hand-holes generally provided in the crank case and unscrewing the nuts that hold the two halves of the bearing in place. After this has been done the piston may be pulled out through the top of the cylinder and the rings will be ready for inspection.

Each ring should be loose and should not bind in any portion of its groove, whether it be pushed in or out or be turned either way as far as the pin forming the stop at the notches in the end will allow. If it is found that a ring is stuck in its groove it is probably due to a deposit of carbon and gummed oil rather than to any mechanical defect. Great care should be taken in loosening the ring and the gummy substance should be dissolved by the application of kerosene or gasoline at every accessible portion.

Then a small screwdriver may be placed under one of the free portions between the ring and its groove and gradually worked around until the remainder is loosened; but the ring should never be bent out from its end, as this would be almost certain to snap it in two. A broken ring is not only useless, but will do actual harm if the motor is allowed to run under these conditions, and as it is not a particularly easy matter to fit a new one in place, rings should be removed only with the greatest care.

Even though the sticking is caused only by a small amount of gummed oil that can easily be dissolved, the ring should be removed in order that it and its groove may be scraped out and cleaned thoroughly. The ring should be thoroughly loosened before any attempt is made to remove it and then it should be worked out gradually in sections, wedging each part out with a stiff wire to prevent its return to the groove. When the ring gets entirely out of its groove it may be slid along the outside of the piston and off at the end, but if more than one ring is removed at a time care should be taken to distinguish them, as each should be returned to its own groove. If the motor is small and the ring is not too stiff, the latter may sometimes be removed by pulling a piece of stovepipe wire between the ring and piston and following this action with the fingers of one hand to push the ring up on the piston as it leaves its groove.

It may be that the ring has been hurriedly fitted at the factory and put in place without having been properly finished. This will cause it to stick in its groove, even though the oil has not gummed, and consequently it should be tested for a good fit before being returned to its place. After the carbon and gummed oil have been removed the ring may be tested for size without returning it to its groove by rolling it around in the groove so that each part will come in contact with the portion of the groove in which it ordinarily rests. In order to have these portions "register" the ring should be held upside down and started with one end placed against the pin forming the stop in the groove.

Whenever there is the slightest binding between the sides of the ring and the groove such portions should be marked in order that the parts that need grinding may be determined. If it is found that the ring is a comparatively tight fit in its groove so that absolute freedom of motion cannot take place, it may easily be ground down with a piece of fine emery paper. This emery paper, or cloth, should be laid on a flat surface and the ring placed upon it. Then, by pressing firmly upon the ring with the fingers and giving it a rotary sweep with the hand over the rough surface of the emery cloth, the side that is lying down will be ground off slightly.

If the ring seems to be too thick throughout its entire length the pressure of all of the fingers should be evenly distributed, but otherwise only those portions at which the binding takes place should receive the greatest weight. By alternately testing the ring in the groove in the manner already mentioned and grinding the thick portions as described above, a perfect fitting ring and one that should do its share in holding compression for a long time to come may be obtained quite easily.

If the entire cylinder has been removed to reach the piston a little care will need to be exercised when assembling the parts. After the rings are in place the piston should be moved to the bottom of its stroke and held in a vertical position with the engine bed while the cylinder is slid over it. The lower edge of the cylinder walls will probably be beveled to allow it to slide easily over the rings as they project from their grooves, but the cylinder must be set on very slowly and not forced, for any undue pressure will mar the edges of the rings and result in scored walls and eventual leakage of compression.

Care should also be taken to keep the rings in their proper position with their notched ends, or joints, surrounding the small pin provided in each groove. If the ends of any ring move around beyond this pin forming a stop the joints of all rings may eventually fall in one straight line, in which case an easy escape for the compression would be furnished. The joints of adjoining rings should always be placed on opposite sides of the piston.

If the cylinder has a removable head and the piston has been withdrawn in order to repair the rings, its return to its place may be greatly facilitated by a simple device. The piston will set easily into the cylinder until the first ring is reached, after which it will be evident that each ring must be compressed tightly in order to fit within the cylinder walls. The device in question consists merely of a piece of annealed stovepipe wire—which is flexible and yet strong—about a foot longer than the diameter of the piston. Each end of this should be twisted around the middle of a wooden handle, which may be cut from a broomstick.

By crossing the wire near the handles a loop will be formed which should be placed around the ring that it is desired to compress after the piston has been set in position. When this is done a steady pull on the handles will furnish a leverage that will easily serve to compress the ring so that the piston will drop into place until stopped by the next ring. By dealing with all rings in the same manner the piston of even a large motor may be set in place in its cylinder in a surprisingly short time and with very little trouble.

If all of the rings have been examined and it is found that the cause of the loss of compression does not lie with them, it is probable that some of the packing has been loosened or blown out, thus furnishing a vent for the escape of some of the gases. Of course, it is possible that the spark plug is not a good fit or that the relief or priming cock valve has loosened, but the escape of compression and exhaust gases from such an outlet would be so apparent when the motor is running that even the tyro would not look farther for the leak and would tighten these parts before examining the rings.

Escape of compression through the packing of the cylinder can only occur in those motors having detachable cylinder heads. But such trouble is easily remedied and should not be considered as an offset to the many advantages possessed by this type of motor. When it is found that there is a leak in the cylinder packing the head should be unbolted and both surfaces thoroughly cleaned. The old packing that cannot be picked or torn off should be first soaked with kerosene or gasoline and then scraped with a putty knife, or other flat, broad-bladed instrument, until the top of the cylinder and the bottom of the cylinder head are perfectly smooth.

Although the packing of the cylinder head is not directly exposed to the heat of the exhaust gases, the walls and surfaces between which it rests will become rather hot through conduction. But this "gasket" also serves as a packing for the water jacket between the cylinder and its head and consequently the joint must be waterproof as well as able to withstand an appreciable amount of heat. Asbestos and rubber packings are made especially for this purpose and either will give satisfactory service when cut to the proper size and shape and held securely in place by the bolts that pass through the cylinder head.

One of the most effective packings, however, and one that is the easiest for the amateur to apply, can be made from heavy, tough brown paper or drawing paper. Such a gasket will prove to be gas and watertight and will not be affected by the heat of the iron surfaces of the cylinder and its head between which it is placed.

The best manner in which to apply such a gasket is as a sort of shellac-and-paper sandwich of the "double-deck" variety, composed of several layers of each ingredient. In order to cut each piece to exactly the proper shape and size the paper should be laid over the top of the cylinder on the surface on which the gasket is to be placed. By holding the piece firmly in place and tapping the edges and outlines of the iron surface through the paper with the round or "peening" end of a machinist's hammer, the paper will be cut to the proper shape. The edges of all bolt holes and water jacket openings in the surface should also be tapped in this manner, but care should be taken not to strike so heavily that the threads of the bolt holes will be injured. The tapping should be sufficient to break the paper and care should be taken to prevent the gasket from moving before the entire outline is finished.

Three or four gaskets should be made in this manner and then a coat of shellac should be applied to the surface of the top of the cylinder. On this should be laid a gasket in exactly the same position as that in which it was cut so that all outlines, holes and openings will "register" and then the gasket itself should be shellacked. This should be continued until all gaskets are in place, each being separated from the others and from the iron surfaces of the cylinder and head by a layer of shellac.

The gaskets should be laid in place quickly before the shellac will have an opportunity to dry. After this "sandwich" has been "built up" and the last gasket has been treated to its coat of shellac, the cylinder head should be bolted in place as tightly as possible. The motor should not be run for a few minutes until after the shellac has had an opportunity to "set."

The above treatment is almost certain to cure any case of leakage of compression from the cylinder proper and the renewal of this packing may cause an increase of from ten to twenty-five per cent in the power developed by the motor. But there is another source of trouble which is oftentimes overlooked in the search for the missing horsepower. This is the crank case compression, or the compression formed in the base by the *down*-stroke of the piston and used to force the charge upward into the cylinder. This is the principle used on what is known as the "three-port" type of two-cycle motor, and while this compression does not amount to more than from ten to fifteen pounds per square inch, the escape of even a small part of it is vital, for it is the actual explosive mixture in its most concentrated form that is lost.

Practically everyone who has had experience with this type of motor is familiar with the "crank case explosion" that occurs whenever too weak a mixture is admitted to the engine. As a rule, such crank case explosions are more startling than harmful, but occasionally the force of the pre-ignited gases will blow out a part of the packing between the crank case and removable base plate with which nearly all motors are provided in order to render the connecting rod bearing accessible. If it is found that this gasket has been so damaged a new one may be cut out in the same manner as that described for the cylinder head packing, but it is better to use only one layer of heavy paper rather than several gaskets of a lighter weight.

As it is frequently necessary to reach the interior of the crank case by removing the base plate, the gaskets for this portion should not be shellacked. This gasket, however, is not subjected to high pressures and does not need to be absolutely watertight and consequently the application of oil or grease on both sides of the packing will serve the purpose almost as well as will shellac and at the same time will prevent the gasket from sticking to the base plate or crank case when the former is removed.

As a further precaution against the escape of crank case compression, none of the plugs, oilers, and pipes leading to the base of the motor should be allowed to jar loose. It may sometimes happen that the valve on an oil cup will become stuck and allow the compression to force its way back against the lubricant, but such a condition will generally be indicated by a very apparent spluttering and bubbling.

It is not only the fact that a leak in the crank case allows a part of the incoming charge to escape that reduces the power of the motor, but the dilution of the remaining mixture, as well, will cause irregular running of the engine. On the up or compression stroke of the motor, a partial vacuum is formed in the crank case. This vacuum should be filled only by the incoming gas, which has already been properly mixed at the carburetor, but any leak in the crank case will furnish an entrance through which air will find its way and thus dilute the explosive charge.

With the rings, gaskets, oil cups, and oil-hole plugs in good condition, there is only one route by which air can be taken into the crank case, other than by way of the carburetor. This is through the crank shaft bearings, for if these have become loosened or worn, an easy passage is formed for the escape of the gas and the admission of the outside air. The crank shaft bearings, of course, should not be set too tight, or they will bind and soon become worn, but on the other hand, there should be no perceptible "play" between the crank shaft and its bearing surfaces.

Under proper conditions, the film of oil that should be kept on the bearings from the lubricator or from the crank case will serve to make an air-tight joint between the shaft and the surfaces on which it turns. But let even one bearing run for only a short time without oil, and the softer bronze or babbit metal will become worn, "chewed," or "burned out" in an astonishingly short space of time; and even though the normal supply of oil be resumed, a new bearing will almost certainly be required. This furnishes, to the amateur, one of the most puzzling causes of loss of power in a motor, and while the installation of a new bearing will render the engine as sturdy and vigorous as ever, the inaccessibility of this part of the motor makes the bearing the last place to which the motor boatman will look for power leakage. It is only when he has exhausted every other resource and has proved to his own satisfaction that the rings, packing, and other joints are tight that the novice will realize the important part that properly-set crank shaft bearings play in the behavior of his two-cycle, three-port motor.

Many an owner has claimed that he has obtained greatly increased power from his motor by a change in carburetors, but, as a rule, this is probably due as much to imagination as to any material advantage gained. When a good motor leaves the factory, it is supposed to be provided with a carburetor of the proper size and type, and, as a rule, the less "monkeying" with this part of the engine, the better. But the carburetor equipment is designed for a certain normal speed of the motor, and it may be that, owing to a slight change in the pitch or size of the propeller, the motor will "turn up" faster than was the case in the factory trials. In this event, the carburetor with which the motor was originally provided may not have a sufficiently large air opening to supply all of the cylinders with enough mixture at this increased speed, and in consequence the engine may "starve."

The remedy, of course, lies in the change to a larger carburetor, but this should not be installed until it is made comparatively certain that the motor really is "starving." A motor suffering from this ailment will run well when throttled, but on the high speeds will miss and backfire and seem to suffer from lack of fuel in somewhat the same manner as has doubtless been noticed when the gasoline supply is about to become exhausted.

These few hints on the common causes of the loss of power in a new motor should not make owners dissatisfied with their purchases and wonder if they are "getting their money's worth," for "leave well enough alone" is a motto that could be applied to good advantage by many a power boatman who sets out to discover the source of a supposed loss of power, only to find that his craft was doing its best in the first place and that his hoped-for improvements turn out to be serious handicaps.

## CHAPTER V

### HOW TO INSTALL A MARINE POWER PLANT

THERE is a certain fascination about the work we do ourselves that makes the enjoyment of the man who chugs along at seven miles an hour in his little two-horsepower, home-made motor boat equal to, if not greater than, that of the millionaire who sits at the wheel of his twenty-eight-mile-an-hour racer and gives his "dust" to every other craft in sight. The difference in speed between the two boats may be great and the difference in price greater, but the sense of ownership and pride is the same, and the one can speak as boastfully of "*my* motor boat" as can the other—for is not that craft which is the product of his brain and labor and the skill of his hands more truly *his* than the one which merely represents a certain cash investment?

There are many men who, owning a staunch sailboat, skiff, or canoe, desire to replace the old wind and muscle power with something which is at least stronger and less easily tired than these fickle human energies. The result will be seen in the number of former "non-power" craft converted into good, bad, or indifferent motor boats by the installation of a small gasoline engine. By this it is not meant that the best way to build a motor boat is to buy an old hull and to stick therein a cheap or second-hand motor, for unless one or the other of these is already on hand, it will be far less expensive in the end to purchase a new craft outright. It is only for those who already own a good hull of some kind and desire to change the power that the proper installation of a good motor offers the possibilities of a cheap and efficient power craft.

Whether the craft resulting from the combination of a certain motor and a certain hull will be a success or not depends almost as much upon the manner of the installation of the one in the other as upon the quality and kind of these parts of the completed motor boat. A well-made hull of good design may be almost ruined by a poor motor, while the highest-priced engine on the market will be of little avail in any boat if proper attention has not been given to the details of the bed, log, stuffing box, arrangement of the shaft and piping, and other features of a marine engine installation.

With the sailboat, skiff, or canoe already on hand, the first problem that presents itself is the selection of the proper size and kind of motor to be installed. This problem will not be a serious one if it is remembered that too much power is far worse than too little and that it is better to jog along comfortably at seven miles an hour than it is to have both occupants and hull shaken to pieces in an effort to obtain ten miles with a larger engine. The average sailboat, skiff, or canoe is not designed for high speed or the application of great power and it is useless to consider the conversion of any one of these hulls into a "racer"—both because the construction will not admit of the installation of a large engine and because the general lines of such a model are not suited for travel through the water at a rate more than one and one half to two times greater than that for which it was originally intended.

For ordinary purposes, then, it may be stated that a one-horsepower motor is sufficient for a canoe, twice that power is ample for a skiff, and an engine developing twelve horsepower should be enough for a twenty-five foot sailboat. Of course hulls of these models which are made especially for the installation of power would not be affected by these limits, and occasions may arise in which the use of considerably larger engines than those mentioned may be found advisable. The above figures, however, will apply to the case of the average man who owns a good hull which he desires to convert into a power boat.

For all hulls under thirty or thirty-five feet in length, the two-cycle motor is the best form of power plant, for in these cases low initial cost and simplicity of construction are preferable to economy of operation. While it does not pay to put a poor motor in any hull, it is equally absurd to purchase an expensive four-cycle engine for installation in a boat which, at the best, was designed only for eight or ten miles an hour.

Of course, if the four-cycle motor is already on hand, or a good one can be obtained at a bargain, the situation is changed, for it is chiefly the higher initial cost of this type of engine that excludes it from competition in a case like this with the simpler two-cycle motor. With the field thus restricted to a certain type and size, the selection of the proper motor for the converted hull is a matter of reliability and substantial construction —and these are qualities which will be found in the majority of marine engines built to-day.

The most important part of the installation of a motor in a boat is the bed. If these hulls were not originally intended to be power driven and cannot accommodate a large motor because of the excessive vibrations, it is evident that whatever engine is installed should be so arranged and placed that these vibrations will be reduced to a minimum. Even the seams of a stout sailboat may be opened and the planking and rivets loosened because of the violent shakes and throbs transmitted throughout its whole length by a large or poorly installed motor. When you add to this difficulty the fact that no pleasure can be found in riding in a craft having such excessive vibrations, it will be seen that upon the proper installation of the motor depends, not only the life or endurance of the hull itself, but the comfort of the passengers and the degree of usefulness of the boat as a pleasure vehicle.

Even the smoothest running and most perfectly balanced motor is bound to vibrate when running under load, and when improperly installed, such a piece of perfect mechanism may be placed on a par with the worst bone shaker that ever deserved a grave in the junk heap. There should not be the slightest looseness between the engine base, its bed, and the hull and keel of the boat, for such a condition will be aggravated by the running of the motor and in a short time the whole power plant will be shaken loose and the shaft may be sprung or weakened.

In the effort to keep down weight in an installation of this kind, the tendency seems to be to select blocks of wood and timbers that are entirely too light, and the result is an engine bed which, while probably of the proper shape, is not sufficiently heavy to absorb the vibrations. It is far better that the bed should be composed of timbers unnecessarily heavy rather than that the motor should be forced to run on too flimsy a foundation; the disadvantage of the extra weight will be more than counter-balanced by the longer life of the hull and the increased comfort of the passengers. Of course this does not mean that "three-by-sixes" should be placed in a canoe, but on the other hand it would be far better to use these heavy timbers in the little craft than to employ crosspieces and stringers scarcely larger than the "lath and scantling" found in some of the converted canoes and skiffs.

While no definite rule can be given as to the size of the timbers to be used in the engine bed, in general it may be said that pieces less than one and one half inches thick are insufficient for any power plant, while twelve and fifteen horsepower motors may require stuff three and more inches in thickness. A good deal depends upon the design of the motor; a ten-horsepower, single cylinder, heavy-duty engine, for instance, would require a heavier bed than a motor in which the same power was distributed among two or more cylinders.

The size of the stuff to be used also depends much upon the kind of wood, a bed of soft pine requiring heavier timbers than one in which oak is employed for the same motor. Oak is probably the most solid and substantial engine bed, although for small motors installed in light canoes or skiffs teak is sometimes preferred. The latter is more expensive, however, and will seldom be found except in the higher-priced, " ready-made " motor boats. White pine, although used in some of the cheaper grades of boats, is too light and soft for constant service and the bolts and lag screws are liable to work loose much sooner than would be the case were a harder wood employed. For the larger boats, when oak is unavailable or too expensive, rough hemlock timbers will be found to give good service in an engine bed and to form a satisfactory substitute for any better grade of wood.

Of equal importance with the size and kind of material used is the manner in which the pieces are arranged to form the engine bed. The general form of the bed should be such that the vibrations from the engine are distributed over as great a length of the hull as is practicable. A motor which is set on a bed no larger than the engine base will concentrate its vibrations on that one small section of the hull on which the foundation is installed; the consequent shaking of the entire boat will be much greater than would be the case were the result of the impulses distributed over a greater area.

In far too many of the ready-made motor boats of the cheaper grade the engine bed is merely a square, boxlike affair to the upper edges of which the engine base is bolted and forms the cover, as it were. Such a construction can give no permanence or solidity to the foundation and is more often the cause of a rattle-box sensation and sound in the craft than is a poorly designed motor.

At first glance, it might seem absurd even to consider the conversion of an ordinary twenty-five foot catboat into a power craft, for its broad beam and general tublike and bulky appearance naturally indicate that the energy of any motor would be wasted in trying to drive it more than four or five miles an hour. Appearances are deceptive, however, for such a hull when slightly altered at the stern and equipped with a properly installed motor of ten or twelve horsepower can comfortably carry a dozen persons at the rate of ten miles an hour, or better. The decks would, of course, have to be cut down in order to give a greater capacity to the cockpit, but this merely involves work that almost any carpenter can perform.

The main part of the engine bed for a craft of this kind should consist of two oak or hemlock timbers from twelve to eighteen feet long. These should be "three-by-sixes" and should be set on edge along the bottom of the boat on either side of the keel and at a distance apart about six inches greater than the width of the engine base. Each should be secured to the hull by means of long bolts and nuts passing entirely through the timber and the ribs and planking of the boat.

On the outside of the hull where the ends of the bolts pass through the planking, washers should be placed and the nuts screwed on tightly, both being countersunk so that the hole may be plugged afterwards and the entire surface made smooth. These bolts should pass through at least every other rib over which the timbers are set, for it is upon these that the solidity of the engine bed depends.

The crosspieces upon which the engine itself is placed do not come in contact with the hull but are secured directly to the long timbers. These crosspieces, two, three, or four in number, depending upon the length of the engine base, should be about the same width and thickness as the long timbers and of such a length that, when standing on edge, the ends fit snugly down between the large pieces. They should be secured in this position by long "lag screws" passing through the large timbers and into the ends of the crosspieces. The various crosspieces may be trimmed down to allow for the required slant of the motor in order that it may "line up" with the propeller shaft.

By means of this construction the weight and vibrations of the motor are distributed over a length of hull equal to the length of the large timbers, and if the motor is securely fastened to the different crosspieces by means of heavy lag screws, neither power plant nor bed can be shaken loose easily. This same principle should be applied to the construction of beds for smaller motors in skiffs and canoes, but it is manifestly impossible to distribute the vibrations over so great a proportion of the length of the hull as is the case with the installation in the catboat.

In the larger boat most of the engine bed is placed under the floor, and the long timbers are consequently not in the way. In canoes, skiffs, and other boats not large enough for a flooring, however, the long pieces would interfere seriously with the carrying capacity of the craft, and consequently these timbers cannot be over four or five feet long. Even this length may seem to occupy an undue amount of space, but this sacrifice is preferable to the excessive vibrations and discomfort that would be sure to accompany the use of a shorter bed. By means of a little ingenuity, this seemingly waste space between the ends of the long timbers may be utilized as a seat and locker for tools and engine supplies.

The location of the motor is a matter which rests entirely with the owner, depending upon the purposes for which he intends to use the boat. The majority of low-priced, ready-made boats have the engine installed in the extreme stern, but in the case of the converted canoe, skiff, and sailboat the motor may be located in almost any portion of the cockpit desired. It will generally be found desirable to locate the motor in the extreme stern of the canoe, for the carrying capacity of such a craft is none too large at the best.

In the skiff, on the other hand, the best design seems to be to place the engine just aft of the forward, or oarsman's seat, and to operate the boat from this position. This leaves the middle seat and the comfortable stern seat available for three or four passengers and is a design popular with guides and fishermen who have converted their old rowboats into motor skiffs.

Another advantage of this location is found in the fact that the average skiff is not designed for a speed much in excess of the four or five miles an hour attained in rowing, and when the motor is installed and a speed of double this amount is reached, the boat tends to "draw down" at the stern. The skiff will not run as well in this position, and it is consequently advisable to shift the weight so that the bow will be brought to its normal level—a condition which is more easily obtained by placing the motor and operator well forward.

The tendency for the stern of a boat to draw down when the craft is under higher speed than that for which it was designed will be exemplified particularly well in the case of the converted cat, and even the weight of the motor and operator if placed forward will hardly serve to overcome this. Rather than transform the stern of the hull from the fantail shape to the torpedo or V-transom type, a wide sheet-iron plate, as described in a previous chapter, can be built out around the stern at the water line; if this is sufficiently large and properly braced it will aid greatly in keeping the boat in its normal position while under way.

The farther forward the motor is placed, the longer will be the propeller shaft required, for the wheel should revolve near the stern extremity of the hull, no matter in what part of the cockpit the motor is located. While this will increase the expense of installation by the cost of the extra length of shaft required, the additional outlay should be partly compensated for by the higher efficiency of the craft.

Not only must the engine bed be solid, of the proper size and design, and rigidly secured to the hull, but the motor must be placed upon it in exactly the right position, for otherwise its crank shaft and the propeller shaft will not "line up." If these two shafts are not in perfect alignment, the propeller shaft will be sprung and there will be undue pressure created on the bearings in which it revolves. The result will be not only a great loss of available power, but "frozen" and ruined bearings as well. Where a universal joint is used as a coupling, the motor may be set perfectly level and the propeller shaft may leave the boat at almost any angle desired, but this is an installation found only on the more expensive type of boats using four-cycle engines and is hardly to be considered in connection with a converted power craft.

In order to line up the motor properly with the propeller shaft, the crosspieces of the bed should be so trimmed down that the base of the engine, or crank shaft, is inclined at approximately the correct angle. Then, after the propeller shaft is installed and occupies its permanent position, the motor may be tilted in either direction or raised or lowered until the couplings of the two shafts form a perfect joint. Thin pieces of tin or sheet-iron placed under the proper lug or portion of the base of the motor, between it and the crosspiece upon which it rests, will serve to change the position of the engine slightly; by various combinations of these in different parts of the bed, the correct angle can be maintained.

When the base is secured firmly in place by means of the lag screws, these thin pieces of iron or tin will be found to form a rigid support. It is not advisable, however, to trim down the crosspiece to such an extent that more than three or four thicknesses of these "shims" will be needed, for the motor should rest as closely to its wooden supports as possible.

It is evident that great care must be taken at the point in the keel through which the propeller shaft passes in order to render it watertight and at the same time provide a bearing that will not restrict the free revolution of the shaft. This double service is accomplished by the "shaft log," which is a long block of wood through which the shaft passes. One end of this log is trimmed to the same angle as that made by the shaft and is attached to the keel by means of heavy lag screws or bolts. The joint thus made is rendered watertight by the copious use of white lead and paint.

The shaft passes through a stuffing box attached to the square end of the log, and at this point also plenty of white lead should be used. A stuffing box is similar to a short section of brass pipe, threaded on one end to accommodate a cap of the same material. Inside this cap is a shoulder which fits closely around the shaft. If a suitable form of packing is wound around the shaft at the end of the brass-pipe section and the cap screwed down closely over it, a watertight joint and bearing will be formed in which the shaft can revolve with no more resistance to overcome than that furnished by the friction of the packing.

In some boats the log is attached inside the hull to the upper surface of the keel, while in others it is fastened in the water on the under side. In the former case the stuffing box is much more accessible and the packing can be renewed more easily than would be the case were the "outboard" type used and is evidently the better design for a converted motor boat.

The outer end of the shaft near the propeller should be carried in a bearing supported in a "hanger" which is screwed to the keel of the boat. This does not apply, however, to the fantail type of stern, in which the propeller is attached to the shaft very near the point at which it leaves the hull. The bearing in the hanger is, of course, water lubricated, and almost any good brass or bronze bearing material may be used as desired.

It may happen, however, that some foreign substance, such as a small piece of gravel, may find its way in between the bearing and the shaft and "chew" the latter to pieces and "freeze" the two together. To replace this destroyed bearing will rquire more time and trouble if it is of brass or bronze than would be the case were it composed of babbit metal; in consequence it is sometimes advisable to use the latter material for the hanger bearing.

It is a good idea to mount this bearing on a pivot in the hanger so that it may turn through a small arc in the vertical plane. This will allow the shaft to adjust itself more easily to the position of the stuffing box and will provide for any slight settling or warping of the keel of the boat, which would have a tendency to throw the two bearings out of line and thus induce an additional strain on the shaft. The shaft should be placed in its proper position in the stuffing box and hanger bearing before the motor is lined up with it, as it is more easy to adjust the latter than the former.

It can be assumed that every sailboat, skiff, or canoe converted into a power craft is to be used as a "knockabout" and general utility and pleasure boat, that it will explore bays, rivers, and streams that an expensive racer would not dare to navigate, and that, in general, although by no means a fool, it will rush in where a better boat will fear to tread—through danger of treading on the bottom with its delicate hull and propeller. To obtain the fullest service from one of these converted boats, then, it is necessary to protect the propeller and rudder with a heavy skag, or bar of iron attached to the keel and the hanger or rudder post.

The size of the gasoline tank necessary depends upon the power and kind of motor whose fuel it is to carry, and upon the purposes to which it is intended to put the boat. As a rule, a fifty-gallon tank is none too large for a heavy twenty-five- or thirty-foot converted sailboat driven by a twelve- or fifteen-horsepower, two-cycle motor, while a supply of five gallons of fuel is sufficient for the purposes to which a converted skiff or canoe would be put.

In nearly every case the best location for this tank is in the bow, for the tendency of this portion of the hull to rise out of water when under way provides a good "head," or pressure, to the flow of the fuel. The tank should be of galvanized iron or copper and should be thoroughly tested before installation to make certain that there are no small leaks at the soldered joints. It must be remembered that gasoline can find its way through an opening so minute as to be practically watertight.

In the converted skiff or canoe, the muffler should be located alongside the motor and the exhaust piped directly to it and thence to the open air through a hole cut in the side of the boat near the gunwale. If this outlet is placed too near the water line, the muffler and exhaust pipe are liable to be filled with water which will eventually find its way into the engine cylinder and cause difficulty in starting—if not actual harm to the motor.

When the motor is located in the forward part of the hull, as will probably be the case with the converted skiff, the exhaust gases may be blown back upon the other occupants of the boat when the wind is quartering on the muffler side. This, at times, may be disagreeable, but there is no remedy for it unless the exhaust should be piped to the stern. This may be done in the converted canoe when the motor is located in the extreme stern, but the extra space utilized by the exhaust pipe running throughout the greater part of the length of the cockpit generally renders such a design impracticable for the converted skiff. This difficulty is easily overcome when a motor is installed in a catboat or other medium-sized sailboat, for here the exhaust pipe may be run under the floor to the stern of the hull and no valuable space will be occupied.

The batteries and coil of the ignition system should be protected from rain and spray at all times, for these combine to form the "heart" of the motor, which is easily affected by the slightest moisture. When a boat is equipped with lockers, a place convenient and accessible and at the same time dry may be found easily.

In the case of a converted skiff or canoe, however, in which no locker space will be provided, a box containing the batteries and coil may be fastened under one of the cross seats. The open end of this box may be protected by means of a waterproof canvas or rubber flap attached to the edge of the seat and buttoned to the under side of the box. This will keep the contents of the box dry and at the same time will render them easily accessible.

So much for making a bona-fide motor boat. Now for the motor as an aid to sails. With a little gasoline engine, commonly known as a "kicker," installed in the sail boat, the craft may forge its way against tide or current that would give untold trouble were wind alone relied upon, harbors can be made without the necessity of waiting for a favoring breeze or a "tow," storms can be weathered safely in an open sea, and canals can be navigated at a speed that would cause the old tow-path mules to prick up their ears with astonishment and kick up their legs with the desire to avenge a wounded pride. If the cruise is to be long and the time short, so that a regular schedule must be maintained, the auxiliary power may be used to supplement the wind—if the craft is riding on an even keel—and in days of absolute calm, a consistent and regular, if slow, speed may be maintained.

When installing a "kicker" it must not be forgotten, first of all, that the craft is essentially a sail boat, and consequently none of its sailing qualities should be sacrificed to the auxiliary power. To be sure, a well designed racing yacht of fine lines could not be provided with even small power without some reduction in her original sailing speed, but the average cruiser, sloop, or "cat" will suffer very little from the proper installation of the correct type and size of motor.

As the installation of power in a sail boat is only for auxiliary purposes, the question of speed should receive but secondary consideration. A sail boat model can never be converted into a speedy power craft hull, and if the anxious owner can once get the idea out of his head that it is "miles per hour" that he desires when he installs a "kicker," his task will be greatly simplified and cheapened. Six miles an hour is plenty of speed for an auxiliary sail boat of average size, and if a speed of eight or nine miles can be obtained without too great a sacrifice of cockpit space, the owner may be considered lucky in possessing a hull that so readily lends itself to power craft purposes.

In general, it may be said that more than double the power would be required to drive the craft at eight miles an hour than would be found necessary to obtain a speed of six miles, and as space on an ordinary sail boat is valuable, the increase in engine room would scarcely be warranted. Of course, if provision is made for auxiliary power when the craft is built, an engine of almost any size, within reasonable limits, may be installed, but the ordinary sail boat furnishes only a limited amount of room in which a "kicker" can be placed.

In view of the fact that the power and speed of the boat are to be subordinated to roominess and interior arrangement, the selection of the proper size and type of motor that is to form the "kicker" becomes an important subject. It is for this kind of work that the slow-speed, "heavy-duty" motor is particularly valuable, and its greater weight, which precludes its use in racing or semi-speed boats, does not form a sufficient objection to overcome its many advantages as auxiliary power in a sail boat. Such a motor can be obtained in greater horsepowers per cylinder than can the lighter, high-speed engines, and this, in itself, constitutes an important point in the selection of the proper power plant for the sail boat.

Six or eight horsepower is a size of "kicker" often used, and while this can be obtained in a single cylinder in the slow-speed type, the same power would probably be distributed over two or three cylinders in a motor of the lighter and higher-speed design. To be sure, high-speed racing motors of eight, ten, and even higher, horsepower per cylinder will be found in many a boat, but these are parts of multi-cylinder engines developing a horsepower running well into the hundreds and representing a type of power plant totally different from that suitable as a "kicker."

The most convenient out-of-the-way place in which auxiliary power may be installed in a small sloop or "cat" is the 'tween-deck space aft of the cockpit. This space between the keel and the stern deck will probably have been used as a locker, reached by a door opening from the cockpit, and in this case but very little of the cockpit lining need be demolished. With the door closed, it would scarcely be noticed that the craft was equipped with auxiliary power, but of course the compartment should not be so tightly sealed when the motor is in operation.

The distance between the engine bed and the stern deck above will, to a certain extent, determine the size and type of motor that can be installed. The slow-speed, heavy-duty, single-cylinder motor will have a comparatively long stroke, and consequently the entire engine will set somewhat higher than will one of the multi-cylinder type. This stern compartment will, at its best, be rather difficult of access, however, and consequently the simplest and least complicated design of power plant should be used. Thus the single-cylinder motor, restricted in power to a size that will easily fit the 'tween-deck space, will probably constitute the most satisfactory "kicker" for the ordinary small sloop or cat boat. Whether this should be of the two or the four-cycle type depends upon the size of the motor to be installed and the amount of money that the owner is willing to invest in the conversion of his craft.

Single-cylinder, two-cycle motors of five, six, and even higher, horsepowers give satisfactory service and are cheaper in initial cost than are their four-cycle cousins. The fuel consumption of the latter is less for a given power, however, and it is probable that in sizes above eight horsepower per cylinder the saving in the cost of gasoline would warrant the greater investment. If it is intended to use the auxiliary power only in emergencies, however, the two-cycle motor will be the better, regardless of its size, for the depreciation will be less and there will be fewer parts to be kept in running condition.

Even a single-cylinder, two-cycle motor, and one used but infrequently, will require occasional attention, and it is well to make the removable bulkhead or door leading from the engine compartment into the cockpit of sufficient size to enable the engine to be reached easily. If the deck above the motor is solid, the cylinder should not set so high but that a spark plug may be removed or a terminal changed. With any except the smallest type of motor, however, there will not be room between the keel and stern deck to allow the removal of a cylinder for the inspection or repair of piston rings, and the only method in this case is to loosen the engine from its bed and carry it forward to the open cockpit space where all parts may be reached easily.

For this reason, it is probably the best plan to cut an opening in the stern deck above the motor of sufficient size to allow the removal of the cylinder, and thus the "spring overhauling" will not demand the separation of the engine from its foundation. A trap door may cover this opening, but some form of watertight lapping should be used to render the motor as well protected from rain and heavy seas as though it were resting under a thoroughly-caulked deck.

If the cockpit is sufficiently large, the motor may be located in the stern portion where it will be much more accessible than would be the case were it placed 'tween decks. As the craft in which the motor is located is primarily a sail boat, however, some provision should be made for covering over the power plant when it is not in use. This may best be done by constructing a boxlike framework which, when covered, will completely enclose the motor.

The top, sides, and end should be held in place by means of hooks or buttons so that any portion may be removed to reach the desired part of the motor. This framework may be made to include only the motor proper, in which case a smaller supplementary box should be used to enclose the flywheel, which may thus be covered, even when the motor is in operation.

Even though the motor is used only as auxiliary power, it will not belie its appellation of "kicker" unless the foundation is made sufficiently large and heavy. Inasmuch as this auxiliary power will probably be a motor of the heavy-duty type, it is doubly necessary that the more powerful vibrations should be distributed over a large area of planking and ribs of the hull, and the same methods should be followed in installing the motor as those already described.

The intake pipe for the circulating water may be let into the bottom plank near the keel at a point under the pump, while the discharge may be made through the muffler. This discharge jacket water will be turned into steam by the hot gases in the muffler, but the vapor will not be blown aboard except by a strong following wind, in which case, of course, the motor would not be needed. The exhaust pipe should leave the hull above the water line, and it is better that it should be led to the extreme stern of the boat. If necessary, however, the exhaust may be discharged directly through the side opposite the motor, but in either case the pipe should be inclined slightly downward from the engine in order that the system will be self-draining and will free itself of any water which may have washed in through the outlet.

The muffler may be introduced into any convenient portion of the exhaust pipe line, but better results are obtained when this is located as near to the outlet as possible. Aside from the fact that but little valuable space is occupied, one of the chief advantages to be found with placing the "kicker" under the stern deck lies in the easy manner in which the piping is concealed and the consequent absence of any hot pipes which might otherwise be within too easy reach of some of the passengers or crew of the craft.

In the average motor boat, the fuel tank is located under the bow deck. This is a safe location for it, but in the case of the sail boat equipped with auxiliary power, it might be inconvenient to place the fuel tank in a portion of the craft which is otherwise not affected by the installation of the "kicker." While it is not well to have the gasoline tank placed so close to the motor or muffler that the fuel will become unduly heated before it reaches the carburetor, a well-made and non-leakable receptacle can be placed under the stern deck with perfect safety. It may be held in place by means of metal straps secured to the underside of the deck planks or frame work, but care should be taken to make certain that the copper feed pipe is so fastened throughout its length that it cannot shake loose or break from the vibrations of the motor.

A hole should be cut in the deck directly over the filling plug of the gasoline tank. This hole should be covered by means of a good-sized flush plate which, when unscrewed, will furnish an opening sufficiently large to enable a man to reach in his hand in order to remove the cap or plug of the tank.

As long as the size of a single cylinder is limited by the 'tween decks space, a double-cylinder engine may, of course, be used, but some designers and boat builders have found it advisable to instal a twin-screw power plant. In such a boat, two single-cylinder motors are mounted side by side, each of which drives a propeller independently of the other. The arrangement of the foundation will, of course, be different from that described for the single engine, but the principle of the distribution of the weight and vibration will apply quite as well in one case as in the other.

While the installation of a "kicker" is a comparatively simple matter, the man who sails or runs a craft so equipped should bear in mind one precaution. If the motor is located 'tween decks or in any other enclosed compartment, the space should be aired thoroughly and frequently, whether the power plant is used or not. Oil and grease, and possibly gasoline, are almost certain to collect around the engine base, and the vapors from these are liable to form an inflammable mixture with the uncirculated air of the closed compartment. After a motor has been run, the gasoline in the float chamber of the carburetor gradually evaporates, but in the open air this will do no harm, as it is soon dispelled. This emphasizes the advantage of removable covers, doors, and deck plates in the engine compartment, for only in this manner can the enclosed space be aired properly.

This precaution of starting a fresh air circulation through the motor compartment should be taken previous to running the engine each day. Even though the engine is not to be used for some time, the compartment should be aired every day or so. If to this caution be added the one against leaving greasy waste or rags in any part of the boat in which a free circulation of air cannot be obtained, the danger from fire will be reduced to a minimum and even the most apprehensive passenger may feel as free from nervousness when out in a "kicker" auxiliary sail boat as though gasoline were an unknown liquid.

# CHAPTER VI

## ACCESSORIES

A CERTAIN man once bought a motor boat which was advertised as "furnished complete ready to run." It ran all right, but it was easier for him to stand up than to sit down on the hard, uncushioned seats and he had to take a dinner bell and a fish horn along to comply with the law regarding signals; by the time he had purchased all the "extras" needed to make the boat serviceable and comfortable in all kinds of weather he had spent a sum almost equal to the original cost of the boat—but he had as good an all-around craft as any yachtsman could reasonably desire.

It is not necessary to go to this extreme and buy *all* the "trimmings," but very few motor boats in their original condition are equipped with anything more than the attachments necessary for operating the motor and steering the hull, and an additional outlay is always required to obtain all the pleasures possible out of the craft. The "bare necessities" need consist only of the proper number of lights, a whistle or other signal to comply with the law, and a life preserver or two. Cushions on all the seats may be a luxury, but if they are cork-filled and are not fastened to the boat, they may be made to take the place of life preservers, as a cushion two or three feet long has ample buoyancy to keep a person's head above water.

The carrying of life preservers, whistle, and signal lights should not be a matter of law alone, however, for it is decidedly to the owner's interest to equip his boat with appliances which not only make for the safety of other craft in his vicinity, but for the safety of those on board his own boat as well. If life preservers are desired in addition to those which may be formed by the cork-filled cushions, a small "life ring" is probably the best form. These rings have an opening through them large enough to permit the admission of a man's arm and shoulder, and as they are small and compact they can be suspended from the roof of the canopy top, out of the way and yet ready for instant use.

If the boat is inclosed or has a canopy top, it will probably be necessary to display three forward signal lights at night. Two of these must be placed beside vertical guards which serve to enable each to be seen only from the proper side.

In many boats these guards are permanent and the lights are fastened on at the side of the guard with a bracket.

For a small craft, however, these guards are unsightly in the daytime while not serving any practical purpose, and it is well to make them collapsible so that they will not show when out of use. This may be done best by making each guard of a sheet of zinc and fastening it to the roof by two or three "strap" hinges. When not in use these may be turned back so that each lies flat along the roof. When it is desired to attach the lights the guards may be secured in an upright position with a hook and eye. This method of securing the signal-light boards will also allow bulky articles to be carried on any part of the roof.

A whistle or loud "noise maker" of some kind is one of the most important attachments of a motor boat, for not only does it serve as a signal to warn other boats on which side you intend to pass them, but on cruises it is useful in announcing the approach of your craft to locks, drawbridges, and the like, and will thus save much time in waiting for the tender to arrive at the scene of operations. Owing to the noise made by the motor in practically every power craft a loud whistle or siren should be used for signaling in order that it may be heard over the much nearer sound of the engine in the other boat.

For the smaller boats effective hand whistles can be obtained which will serve the purpose nearly as well as would a steam siren. These consist of a large cylinder and hand-operated plunger, the latter of which, when moved, compresses the air and forces it out through a small whistle. This whistle is generally fastened directly to the cylinder, but if installed in the bottom of the boat in this manner the high sides of the cockpit will so confine the sound that much of the effectiveness of the whistle as a signal will be lost. A far better way in a medium-sized craft is to disconnect the whistle proper from the cylinder and place it either on the canopy top (if the boat is covered) or on the bow deck. It can then be connected with the source of air by a few elbows and lengths of brass pipe—an operation which should not take a good pipefitter more than an hour.

Many motor boats are now equipped with a whistle operated by the exhaust from the motor—either taken direct or confined in a separate tank, to be used as desired. Such a signal may be sounded from any part of the boat by merely pulling a cord in the same manner as on steam boats. Another type of marine whistle obtains its compressed air from a tank which is kept filled by means of a small pump connected to the gasoline motor. This pump can be so arranged that it will be thrown into action automatically when the pressure in the tank becomes reduced below a certain amount.

The electric horn is coming into popular favor as a signal for motor boats, owing to the peculiar penetrating quality of its tone and the ease with which it is installed and operated. It may be operated on dry batteries or a storage cell and can be sounded merely by pushing a button located in any convenient place near the wheel. The sound will be continuous as long as the button is pressed.

Although the majority of two-cycle motors on the market are advertised as reversible and nearly all of this type can run equally well in either direction, it is not well to be obliged to depend upon this in case of an emergency, and I strongly advise every owner of a motor boat driven by an engine developing six horsepower and over to equip his craft with some sort of good reverse gear which will operate independently of the motor. Such an arrangement is absolutely necessary if a four-cycle motor is used, for this type of engine, unless specially constructed, will run in but the one direction.

There are two distinct types of reverse mechanisms in popular use among motor boatmen, and while space will not permit a full discussion of the merits and disadvantages of each, a short description of the two is necessary in order that the novice may best know how to equip his boat. Everyone knows that the blades of the propeller are turned at an angle from the plane in which the whole wheel revolves. With the solid type of propeller in which the blades are cast rigidly with the hub, revolution in one direction will give a forward force to the boat while revolution of the wheel in the opposite direction will draw the hull backward.

It will be seen, then, that all that is necessary thus to control the boat is to be able to change at will the direction of rotation of the shaft upon which the wheel is mounted. If this could be done by the engine, with the absolute assurance that it would turn in one direction or the other, as desired, with no danger of stopping at the crucial moment or, what is worse yet, of continuing with renewed power in the same direction from which it is desired to change, there would be no need for reverse gears of any kind. But we cannot have that assurance—and hence the thriving business done by the clutch and reverse propeller manufacturers.

The reverse clutch is the mechanism usually installed directly behind the motor, forming the connection between the crank shaft and the propeller shaft. When the lever attached to this mechanism is thrown in one direction, the propeller shaft revolves with the crank shaft of the motor as though connected by a rigid coupling. When this control lever is moved to its other limit a set of gears is thrown into mesh which causes the propeller shaft to revolve in the opposite direction from that of the flywheel of the motor. Between these positions of the lever is the neutral, at which point the motor may run while the propeller and shaft will remain perfectly still.

The other arrangement is known as the reversible propeller and is quite different in its operation from that of the reverse clutch—although the results are practically the same. With this mechanism the propeller shaft is connected directly to the crank shaft of the motor and always revolves with it. By a lever arrangement and a rod or sleeve which follows the propeller shaft and connects with the wheel, each blade may be made to turn on its longest axis. This serves to change the pitch of the blades in unison, so that almost any desired angle to the plane of revolution of the wheel may be obtained.

When these blades are turned so that there is no pitch, the effect on the boat is the same as though a smooth disc were revolving through the water and, no matter how fast the motor may be running, there will be no power exerted in either direction. This corresponds to the neutral position of the reverse clutch. If the blades are turned farther in this same direction, the pitch of the wheel will be so changed that, whereas there was a *push* against the hull before, there will now be a *pull*, and we have the same result as though a solid wheel had been revolved in the opposite direction. It is evident that with this arrangement almost every variation of pitch can be obtained from the greatest forward angle, through zero, to an equally great reverse angle.

It is a great advantage to be able to change the pitch of the propeller at will while the boat is under way, for by regulating the speed of the motor to the position of the blades a wonderful flexibility of control can be obtained. Then, too, there may be a certain pitch of the propeller at which the highest speed of the boat may be obtained but which, under certain conditions, will allow the motor to "turn up" too fast and cause undue vibrations in the hull. By increasing the pitch of the propeller blades a greater load will be thrown on the engine, which may result in smoother running, although it will probably reduce the speed of the boat somewhat.

It is this flexibility of pitch that is one of the strongest points in favor of the reversible propeller. Another advantage to be found in this type of wheel is the ease with which individual blades may be replaced. It often happens that when a shoal or log is struck, only one "bucket" of the propeller may be damaged. In case a solid wheel is used, the entire propeller must be replaced, and although this is not a very difficult operation when once the boat is raised out of water, one or two extra wheels would occupy a greater amount of space in the boat than would a dozen interchangeable blades for the reverse propeller.

The reverse clutch using a solid wheel has its advantages, however, and it is entirely a matter of personal preference and opinion as to which is the better type to use on any particular design of boat. The hub of the solid wheel can be made smaller than that of the reverse propeller, and consequently slightly better blade design with a greater amount of effective surface for the same size of wheel may be obtained with the former. This feature makes the solid wheel better suited for racing purposes in which it is necessary to take every factor into consideration which will have any effect, no matter how small, upon the speed of the boat. Many a race has been lost and won on such a small matter as a few square inches of effective blade area.

Then, too, it must be remembered that the solid wheel attached to the end of a plain steel shaft is the simplest form of connection between the motor and the water. The reversible propeller requires either a hollow shaft throughout the length of which slides a rod connected to the blade-turning mechanism located in the hub, or a sleeve which surrounds this propeller shaft and operates the same levers for changing the pitch of the buckets as does the rod. This complicates matters slightly, particularly if it is desired to shorten the propeller shaft, and in addition greater attention must be paid to the outboard and inboard stuffing boxes in order that the packing will not be disturbed by the lateral motion of the sleeve or rod.

With both the ordinary reversible propeller and the clutch the speed of the motor must be regulated in connection with the load carried by the wheel. For instance, as the blades are brought to neutral or as the clutch is released, the motor must be throttled down and the spark retarded in order to keep the motor from racing under its decreased load. When the load is again applied, either by increasing the pitch of the blades or by re-engaging the clutch, the throttle of the motor must be opened and the spark advanced in order to prevent the engine from becoming stalled under its increased load.

In order to simplify these operations and to enable complete control of the boat to be obtained by one lever, a reversible propeller has been designed in which the load upon the engine is always constant, no matter what may be the position of the blades. This device consists of two propellers on the end of a single shaft, the pitch of each of which is regulated by one lever located near the motor, as in the ordinary type. For full power ahead each propeller is turned so as to give maximum efficiency on the forward drive.

As the wheel is turned toward neutral the pitch of one blade is changed automatically so that it sets up a resistance against the water sufficient to overcome the loss of load on the motor due to the decreased pitch of the other bucket. When the neutral point of the propeller is reached, one blade is so turned as to develop a forward push, which is entirely counteracted by the reverse pitch of the other blade, which is exerting a backward pull. As these forces are equal and are working in opposite directions, there is no power transmitted to the boat, although the motor will be running at full load. For full speed astern both propellers will be set to reverse pitch.

It will be seen readily that when the load lost by one propeller is gained by the other the load on the motor must remain constant and there can be no racing. With a wheel of this type properly designed the reverse lever may be used alone to control the speed of the boat, and the load may be shifted from full power ahead to full speed astern with scarcely any perceptible change in the speed of the motor.

Very few of the smaller motor boats require both a pilot and an engineer—except that the operator must have some of the qualities and abilities of each. Even a forty-foot cruiser may be managed by one man after the motor is once started, and the ease with which a comparatively bulky boat may be operated is really astonishing. This "one-man control" feature of the motor boat is probably best exemplified in the "auto boat." The steering wheel is generally of the automobile type, having the spark and throttle levers located on quadrants inside its rim. The starting crank and reverse levers are near at hand, and practically every phase of motor boat navigation may be obtained by the one man without once stirring from his seat.

With the boat in which the motor is located in the stern or in the center of an undivided cockpit, such one-man control as that described above cannot be obtained. Nearly all of the larger boats of this type are steered from a wheel in the bow, while the motor is operated by a second member of the party. It is possible to convert such a boat as this into a one-man control type, however, merely by the proper arrangement of the throttle, spark, and reverse levers and the installation of an extra steering wheel.

These control levers should be arranged so that all three come within reach of the left hand, leaving the right free for steering the boat. A simple extension from the throttle may be arranged easily by almost any machinist or blacksmith, and it is probable that the reverse and spark levers will already be located within easy reach.

There are many arrangements for auxiliary steering in use on various motor boats, but probably the simplest and most effective is a small extra wheel attached to the coaming or side of the cockpit opposite the motor. A connection may be made with the rudder line at this point, a few turns taken around the drum of the wheel, and it will then work in conjunction with the steering wheel at the bow without complicating the system to any extent. This extra wheel should not have handles, or grips, projecting from its rim, as these are liable to be in the way and to catch in the clothing of persons sitting near by.

The best form is a small wheel with a round rim. This will furnish a sufficient grip and will be as compact as any device obtainable. Many boats are equipped with a single vertical lever, pivoted at its lower end and fastened to the steering line about in the middle. This is a simple form of control and one easily installed, but the large arc of the circle through which the handle swings when the boat is turned occupies considerable room along the side of the cockpit and is liable to destroy the seating capacity of a locker which may be located within range.

Furthermore, a greater length of steering line will be required when this lever is pushed in either direction from the vertical than will be the case when it is standing upright. This has the effect of making the steering line too slack when the boat is going straight and of tightening it unduly when the rudder is turned hard in either direction. An attachment to this lever can be obtained by means of which the steering line will be kept at the same tension—no matter what the position of the rudder may be. This attachment consists of two sectors of a steel wheel, each having a toothed rim to accommodate the links of a chain fastened to the rudder line.

These sectors may be likened to a part of the sprocket wheel of a bicycle, and as the chain follows the arc of the wheel attached to the lever as it is pushed in either direction, the tension on the rudder chain remains always the same. This is a simple arrangement, but it is hardly as desirable as the small wheel mentioned at first.

Most of the devices and attachments described above have had to do with the management of the boat while under way, but it must be remembered that it is often desirable or necessary to stop and to stay stopped for a while, and when there is no good pier or other landing place available, an anchor will prove itself of as great value as any accessory to be found on board. This will be true particularly if the motor should happen to break down near a shore toward which a strong wind is blowing or a strong current flows, and in this case the anchor may be the means of saving the boat from being smashed or stove-in upon the rocks. It is much easier to repair the motor when there is no feeling of rush or hurry, and when the boat is safely riding at anchor the trouble may be located much more quickly and a better job done than if there was danger of drifting helplessly upon the rocks.

An anchor of sufficient size and strength for holding a medium-sized boat in a good "blow" is not the bulky and unwieldy object that one might think. While there are no "pocket editions," of course, folding anchors are made which can be stowed in a remarkably small space and which can yet be rendered easily available for almost instant use. Such an anchor, together with about two hundred feet of rope, may be stowed in a space two feet long by one foot square and should form a part of the equipment of every motor boat. It will be strong enough to hold a thirty-foot boat, or larger, and the two hundred feet of line will allow of comfortable mooring in almost any river or lake.

These accessories are what might be termed the necessities for every motor boat, for while a craft *can* be navigated without them, each fills its place in helping to make the sport "safe and sane."

There are, on the other hand, several "luxuries" which many a seasoned motor boatman would find it difficult to do without, and although they do not add directly to the safety of running a power craft, each does its share toward making it a more comfortable and pleasant diversion.

In several devices, the combination of safety and comfort is attained to a high degree, a single apparatus serving the needs of both. This is well exemplified in the small lighting plants that furnish power for the search light that enables landings to be made with safety on the darkest night, and that also supply the cabin illumination, as well.

A small, gasoline motor-driven generator of one kilowatt, capable of supplying current for all signal lights and for a couple of dozen ten-candle-power electric bulbs will be found exceedingly useful on the cruiser that can spare a few square feet of floor space in the engine room for the installation of this compact illuminating plant. The generator is driven direct by a two-horse-power, single-cylinder, two-cycle, high-speed gasoline engine, and by means of a small switch board, any or all of the lights may be used as desired. The addition of a small set of storage batteries in conjunction with the generator, enables the lights to be used when it is undesirable to operate the power plant.

Even though its cockpit does not afford room for the installation of the more pretentious electric generating plant, the small open boat or cruiser need not be without a brilliant search-light and means of interior illumination, for acetylene gas can come to the rescue in the form of a very compact and easily-operated generator of a capacity sufficient to meet the requirements of even a large craft. The nuisance of old and half-used carbide has been done away with, and by means of these generators, the very last ounce of the substance may be consumed, even when the lights have been in operation only at long intervals.

This generator is mounted on a horizontal axis set in spring supports and is inverted when it is desired to stop the generation of gas. This inversion breaks the contact of the water with the carbide, and only a small amount of the acetylene, under very low pressure, is stored in the generator. By turning the chamber to its original position, the carbide is again brought into contact with the moist residue, and generation is immediately resumed. One, two, or three units, depending upon the number of lights to be provided for, are mounted upon the single horizontal axis and constitute the entire generating set. A single generator is also made especially for the production of acetylene for one searchlight and one cabin light.

Many a motor boat is afflicted with the ill known as "water in the hull," and the curing of this is to the nautical enthusiast what pumping up the tires is to his automobilist cousin—for both entail about the same amount of backbreaking work. As the power of the motor has come to the aid of the automobilist in helping him pump up his tires, so does the bilge pump relieve the motor boatman of much of the time and trouble of "baling out." Some forms of bilge pumps are attached to the flywheel by means of a friction pulley, while others are a part of the circulating system of the cooling water.

All of these systems operate by means of a rotary or plunger pump, but in a third type, the steam injector principle is applied to suck out the bilge water without the use of any moving parts. The water jacket of the exhaust manifold is tapped and the stream of circulating water between it and the outlet is used to form the suction for the bilge connections. The overflow from the engine circulating water, or all that is not forced through the "injector" with the bilge water, is discharged into the muffler, which is tapped in order to provide for this.

As in all gas engines, the most delicate part of the motor boat power plant is the ignition system. And the man who has been caught out in the rain in an open motor boat will also probably realize that the average ignition system is not amphibious and that water on the spark plug puts as effective a damper on the spirits of the engine as does an empty gasoline tank. But the sight of any ignition outfit consisting of a coil, wiring, and plug entirely immersed in water, with a spark merrily leaping from one electrode of the plug to the other would indicate that the above-mentioned rainy-day troubles of the motor boatman are at an end.

Such outfits as those that gave this astonishing demonstration are not only waterproof, but they are compact as well, eliminate all high-tension wiring, and require but two connections in the whole system. In one type of this system, the "step-up transformer," or coil, is wound around the spark plug so that the latter is practically embodied in the core of the former. The sparking end of the plug projects from the coil, and this is screwed into the engine cylinder in the same manner as is the ordinary spark plug. A circuit breaker, corresponding to the vibrating armature of the ordinary coil, and the set of batteries, form the only parts of this ignition system that are not combined with the coil and plug on the engine cylinder.

Another device similar to that just described combines the coil, condenser, and vibrator in a single waterproof covering that can be attached directly to the spark plug of each cylinder without the use of wires. The electrical connection is made automatically with the tip and shank of the spark plug, and the attachment will fit any standard make.

Spark plugs and coils are not the only parts of the ignition that can be rendered temporarily useless by water, and it is well known that dampness is as disastrous to the life of a dry battery as is excessive use. In order to keep these current generators dry at all times and under all conditions, several forms of battery cases have been devised. These are made in various sizes and will hold from one set of two cells to two sets of eight batteries each. The covers of the boxes are clamped down tightly over a rubber gasket that serves to keep the contents absolutely dry, even when the cases are entirely immersed in water, and all wire connections are made from brass terminals that project through the top and sides of the box.

In one form of battery box, the cells are provided with special screw tops that engage with similar tops that are attached to the lid of the box. These form one battery terminal, while connection is made with the other pole by means of a brass spring in the top of the box over each cell. Connections between the individual cells are made through brass strips set on the inside of the top of the box, and there is consequently no exterior wiring except that leading to the coils and motor. A special switch can be provided on the top of the box by means of which various wiring arrangements between the sets of batteries can be obtained. By this means, either set may be used separately, or both may be used together, either in the series or in the series-parallel arrangement.

Another form of battery box is intended to be used with any kind of a dry cell of the standard size. This box is filled with a waterproof compound into which holes are moulded to accommodate the individual batteries. The cells are thus separated from each other by a waterproof insulating material, and as each fits tightly in its pocket, the batteries are held in place as rigidly as though they were screwed to the cover of the box. Special wire connectors are used between the individual cells, and the current is conducted to the terminals on the outside of the box by means of brass strips. Brackets are supplied by means of which the case may be attached either to the floor or to the underside of a seat or the deck.

Those who want to know how fast their boat is running may now satisfy their curiosity by referring to their speedometer. One type of this device designed for use on motor boats is operated by means of an inlet pipe in the bottom of the boat. The change in pressure, due to the speed of the boat, is shown on a mercury gauge marked to read in miles per hour.

In order to cut down the number of separate tools required on board and to lessen the chances of losing or mislaying any or all, a special device has been designed which in reality comprises eight separate, solid end wrenches in one piece that will easily fit the coat or vest pocket. This consists of four flat, thin, solid end wrenches of the same length placed one above the other and held in position by a centerbolt that passes through a slot cut through the middle of each piece. This centerbolt has a squared shank that keeps each individual wrench from turning, and on its threaded end is screwed a wing, or thumb, nut that serves to keep the four tools held rigidly together when it is tightened.

As the slot through which the centerbolt passes is a couple of inches long, any one of the four wrenches may be slid out from the rest of the nest so that the desired end projects a sufficient distance to be applied to the nut that is to be turned. As there are eight ends of different sizes on the four wrenches, and each tool may be slid to the limit of the slot in either direction, eight sizes of nuts may be wrestled with, and yet only in thickness is the tool larger than a single wrench. A square hole cut near the end of one of the wrenches in the nest serves as a key with which to open or close the valve of a gas tank of standard make.

Another unique type of wrench consists of a pair of adjustable jaws operated by the thumb nut and thread of the well-known "monkey" principle. Opposite the jaws the shank of this wrench is held in an "eye-piece" which is, in turn, mounted in a ratchet joint at the end of a heavy handle. These two joints, the eye-piece and the handle, thus allow the jaws to occupy two different series of positions in relation to the handle. By loosening a thumb nut at the end of the eye-piece, the jaws may be turned through an arc of approximately ninety degrees about their shank as an axis, while the ratchet joint in the end of the handle in which the eye-piece is mounted enables the jaws to be revolved to any position about the eye-piece as an axis.

The ratchet operates in either direction and may be turned on or off by means of a milled nut. It will be seen that, inasmuch as the jaws have any number of adjustments through both a horizontal and vertical plane, independent of the handle, almost any nut can be reached. The ratchet attachment allows the nut to be turned by moving the handle through but a very small arc.

A motor boat is a good deal like a house; it can be made serviceable without great expense, but to be made comfortable and attractive as well, it must be furnished with common sense.

## CHAPTER VII

### COVERS, CANOPIES, AND TOPS

EVEN though the motor boat spends the greater part of its existence in the water, water should spend very little time in the motor boat. No matter how well protected the motor may be, the interior of the boat, the floor boards, the inside of the planking, the seats and cushions, and every part of the equipment and furnishings will give better service if they are kept dry, and it is consequently as much of a duty owed to the craft itself as it is to the passengers to provide some sort of protection from the spray and rain.

To be sure, a man can provide himself with a "slicker" and oilskins and keep as dry in the heaviest rain or spray as though he were snugly ensconced in a cabin, but the subsequent time and trouble spent in baling and drying out the interior of the boat and polishing the rusted metal parts will make the owner wish his craft, as well as himself, could be provided with a set of oilskins. Many cases are on record, of course, in which boats have been run when they were half full of water, but the average motor boat is not a submarine, and the less water that finds its way over the wrong side of the gunwale, the better will it be both for the craft and the occupants.

Every well-treated motor boat is entitled to a boathouse or shelter of some kind in which it may be kept when it is not in use. But the motor boat is not like the turtle and cannot carry its house on its back, and consequently when on camping trips or cruises, if the craft is of the open cockpit type, some provision must be made for a removable covering. An effective protection for this purpose which will completely cover the interior of the boat may be made from stout canvas. This should be made of the same general shape as the outlines of the cockpit, but its width should be slightly greater than the beam of the boat.

Grommets or brass rings should be worked into the outer edge at frequent intervals to fit over hooks screwed in corresponding positions in the outside of the coaming. When the rings, or grommets, are fitted over the hooks, the cover will be held tightly in position, but as the canvas will either lie flat or will sag in the middle, the water will collect in the center and will probably soak through unless the material has been thoroughly waterproofed. Consequently the center-line of the canvas should be raised above the edges to form sloping sides off which the water will run without soaking through.

This is best provided for by taking a stout stick or a narrow board slightly longer than the cockpit and notching this at its edge near each end so that it will fit down over the coaming at the bow and stern. If the canvas has been made of the proper width, it can be fitted down over this board and will be stretched in the form of sloping sides.

Such a covering can be folded and stowed in a small space when not in use. For this reason it is well adapted as a shelter to be carried in the boat on extended trips, and if there is no convenient place in which to store the long center stick, this may be made in two parts and hinged in the middle.

If the motor boat has been purchased before boathouse accommodations have been built to receive it, or if the boathouse is already full and there is no room for the extra craft, the type of cover described above will serve well as a temporary shelter until other provisions can be made. In fact, the writer knows of an instance in which such a cover was made to serve as a boathouse for a small "runabout" for four seasons. In this case, the stern of the boat was fastened by a long line to a pier that projected into the stream for some distance, while the bow rope was tied to a post near the water's edge on shore. This method of mooring kept the boat at a safe distance from both pier and shore, even in the heaviest wind, and the craft was as well protected, both inside and out, as though it had been riding placidly in its slip in the boathouse.

A low-lying cover that protects the entire cockpit does its duty too well to be sufficiently versatile to serve also as a spray hood when the boat is running in a heavy sea, for it allows no room for occupants and can be used only as a shelter when the craft is at rest. It is the unprotected motor that will suffer most in a heavy rain or spray, and consequently the simplest kind of cover must take into consideration the sheltering of the carburetor and ignition system—particularly the latter.

Absurd as it may sound, in an emergency a hat has been found to afford a simple and yet highly effective shelter for a single-cylinder motor, and in many instances the placing of a "sou'wester" over the spark plug has enabled the boat to run continuously through a rain that would have stopped the engine "dead" were this head covering not available. If the motor only is to be considered in sheltering the boat from the rain, an oilskin or rubber cloth jacket, that will fit down over the manifold and carburetor with tapes or puckering strings by which it may be held in place in a high wind, will serve to keep the engine itself in running condition. This is the simplest of all coverings, but it is only to be recommended for temporary use until a more complete shelter that will protect the cockpit as well as motor can be obtained.

The motor boat having a canopy top will doubtless be provided with side curtains which can be let down, completely enclosing the interior of the boat. These serve well as a covering if the boat is to be left out of its slip over night, and they also afford complete protection to the occupants in case of a rain storm. It is probable that these curtains will be divided into sections, and in this case one or more on the windward side may be let down to keep the spray out when there is a heavy head sea running.

This would probably interfere with the view of the steersman and the passengers, however, and as the ordinary spray cloth should be merely an extension of the coaming and does not need to connect with the canopy top, a protection other than the curtain is almost necessary for pleasant-weather-but-rough-water navigation. Such an auxiliary spray curtain may consist of a strip of heavy canvas eighteen inches or two feet wide extending around the bow from the 'midship portion of one side of the coaming to a point directly opposite.

Grommets or brass rings fastened to the bottom edge of this canvas may engage with hooks screwed into the outer side of the coaming. The upper edge of the spray cloth may be secured in the same manner to the upright stanchions, or supports for the canopy top. In order to support the canvas where it rounds the curved coaming at the bow of the cockpit, separate brass or iron rods will need to be used. Casings should be provided in the canvas into which these rods may be slipped, and each of the latter should be supported upright in the coaming by means of two screw eyes placed one above the other.

If the rods are not too tight a fit in these screw eyes, each of the former may be removed when the spray cloth is unhooked, and the entire attachment may then be rolled up and stowed in a small space in one of the lockers. The fact that the spray cloth extends back on each side from the bow to amidships will generally serve to protect the entire cockpit from the flying spray.

A stationary canopy top composed of matched strips of wood made waterproof by a canvas covering, the whole supported on well-secured stanchions, forms a good shelter equipment for a fair-sized motor boat and has the advantage of being more solid and substantial than the removable tops. But many an owner prefers an open boat for short trips and pleasant weather cruising, and the craft of such a man should be provided with a top that is easily attached and removed "on the spur of the moment" before leaving the boathouse.

Such a canopy top may consist of a framework over which stout waterproof canvas should be stretched and permanently secured. This framework may be supported by brass stanchions, the lower ends of which fit into brass guides and sockets secured to the coaming and deck at the proper points. A set screw, or some other clamping arrangement, should be provided for each socket so that the stanchions will be held securely in place and will not rattle and shake from the vibrations of the motor.

This same clamping arrangement may be used to hold stanchions supporting a matched wood and canvas canopy top as described in the preceding paragraph, but unless all parts of the guides and sockets are made unusually large and heavy and are well secured to the deck and coaming, such a removable shelter will be too unwieldy, bulky, and top-heavy to be practical. As a rule, it is better to confine the removable type of top to the more easily handled canvas variety.

Hinged or sliding hatches should be cut in the roof of every permanent canopy top in order to furnish easy entrances and exits to and from the cockpit. On some boats these hatchways are cut in the sides of the top, while on others the entrance or exit is made by way of the bow or stern deck. It is not advisable to cut a flap in the side or end of canvas top, but headroom for entrance and exit may be afforded by attaching a hinged bow to the two front or rear stanchions. This hinged bow will carry the end of the canvas top, and when it is turned to a vertical position and lies alongside the stanchions to which its ends are hinged, the canvas will be folded back between the two supports. A fastening of some sort should be provided to hold the hinged bow in an extended position and thus stretch the canvas tightly when this "hatch" is not in use.

Folding "automobile" tops have come into popular use on many types and sizes of motor boats, and these form a convenient and easily-removed protection from the sun, wind and spray. When extended, such a top is supported on two or more sets of bows that are hinged in brackets set in the coaming, and the entire canvas is stretched tight by means of straps attached to cleats set in the bow and stern decks. Each set of bows can be removed easily from its pivot, or hinge, and transferred to the stern of the cockpit where, by means of other pins, they may be turned back along the deck with the stern set of bows. Then the supports are all "nested" together at the stern of the cockpit with the stretches of canvas top folded between them, and a covering that formerly extended over the entire cockpit can thus be compressed into a wonderfully small space in a short time.

These automobile tops are provided with lengths of side curtains which may be buttoned down to the gunwale, and thus the entire cockpit of the boat may be enclosed in stormy weather. As these side curtains are cut in sections, only that side of the boat on which the spray or rain is driving need be protected, but if it is found necessary to enclose the entire cockpit, the celluloid windows which are placed in the bow "apron" and some of the side strips will serve to make navigation both easy and dry in the stormiest or roughest weather. The bow apron with its transparent front furnishes a good spray cloth, and as in many forms this curtain extends partly around the side of the coaming and slopes toward the stern from top to bottom, the occupants of the rear of the cockpit also can be protected from the flying water and spray of a head or quartering sea.

Adaptations of the automobile top may be used for a variety of boats and shapes of cockpits. The racing motor boat, for instance, having its engine under the forward deck and provided with cockpit accommodations for only two or three persons, need use only a single set of the bows, and as these are pivoted at a common point, the entire covering may be set up in the proverbial "jiffy." With the side curtains and the front apron in place, the cockpit of the craft is converted into a marine counterpart of the doctor's buggy or runabout on a rainy day. This type of hood may also be applied as a covering for the stern deck of a cruiser.

Shelters for this type of boat generally consist of an iron pipe framework used for the support of strips of canvas that may be laced to the top and sides, as needed. Some large cruisers are provided with a permanent canopy top, but the desire to remove the covering in pleasant weather makes the proper form of automobile top or detachable awning the more preferable type. It would be inadvisable, of course, to employ the automobile top as a stern deck covering on a large cruiser, as the broad beam would make necessary the use of bows that would be too wide to support the weight of canvas properly.

An inexpensive covering for a "knockabout" or other boat on which it is not desired to spend much money for a shelter, will be found in the "melon" hood. This obtains its name from the shape that the top assumes when extended, and it is made in as great a number of forms as there are varieties of the vegetable after which it is christened. This hood in its simplest form consists of a set of three or four bent-wood bows, all of which are attached at their ends to a pin set in the coaming on each side of the boat. These bows are covered with a waterproof canvas, the forward end of which is shaped to fit around the forward curve of the cockpit on the deck outside of the coaming.

When the hood is not in use, all the bows are turned forward and lie along the deck outside the coaming, with the canvas folded between them. The canvas, it should be understood, is stretched from one end to the other of all of the bows. Consequently, when the bows are turned up and opened out as far as the canvas will allow, a complete covering is formed over the forward end of the boat and both the sides and the bow are entirely enclosed.

If there are but two bows used and the last one stands vertical, the hood will assume the shape of a "quarter slice" of melon, and if celluloid windows are cut in the bow portion, this size makes a satisfactory shelter for the steersman. The bow end of the canvas is fastened to the forward curve of the coaming by means of the usual grommets and hooks, and consequently by loosening these and springing out the hoops, or bows, from the pins on which they turn, the hood can be removed entirely.

If the cockpit of the boat to be covered is short, the bows of the melon hood may be pivoted amidships, and by doubling the quarter melon size, a protection completely enclosing the entire cockpit will be formed. This, of course, will require two or three more bows than will the other form, but a "half melon" shape will be obtained that will protect the occupants of the boat and its power plant in all kinds of rain or spray.

Another arrangement of the melon hood for a boat having a medium-sized cockpit is to use two of the "quarter slice" shape, installing one at each end so that they will meet amidships when raised. A flap of some kind will need to be used to make a water-tight "joint" between the two. If the cockpit is too long for the two quarter melon hoods to meet, an extra bow may be placed in sockets so that it occupies a position in the middle of the uncovered portion, and to this the extra canvas necessary may be attached. The edges of this canvas may be laced or buttoned to the ends of the hoods that are already in place.

In case the cockpit is too long to be entirely enclosed by one or two hoods without the use of additional bows and canvas, a far different type of covering may be installed to good advantage. While this hood is of the "half melon" shape, its construction is somewhat different from and more elaborate than that described above, but it also admits of a greater variety of uses. In this type, the bows generally consist of iron hoops that straddle the cockpit in the same manner as do the others. These hoops, however, instead of being sewed or laced to the canvas, are attached to it by means of sliding rings. This method of attachment allows the canvas to be slid off the iron hoops—or to one end of all of them, rather—and to lie collapsed outside of the coaming along the deck from bow to stern.

In order to stiffen the edge of this canvas and make it slide more easily and evenly, an iron rod should be sewed into it at one side or the other. If this rod is attached to each hoop by means of a sliding ring, the entire covering may be either opened or collapsed by moving the rod from one side of the cockpit to the other along the hoops.

Thus, if the hoops are in position and the canvas is collapsed on one side of the deck outside of the coaming, it may be opened and made to cover the entire cockpit by sliding the outer edge in which the rod is fastened over to the other side.

The rod and the rest of the canvas will follow along the hoops, being guided by the rings. The rod, of course, should be curved at its ends to fit half way around both the bow and stern of the cockpit coaming, for this is the position that the edge of the canvas must assume when it is either collapsed or wide open.

When the iron rod is slid over the hoops so that the canvas is collapsed and it all lies on the same side of the deck outside the coaming, the hoops, of course, may be turned down flat, as has been described in connection with the first-mentioned melon hood. One of the objections to the other type of melon hood lay in the fact that both sides and overhead must be covered if it is desired to open the shelter at all, and there was consequently no halfway position in which it could serve as a spray hood.

The sliding ring type, however, may be raised up on either side as great or as small an amount as desired, and it thus forms an adjustable spray cloth without interfering with the view, light, and air on the lee side or overhead. The objection may be made to this type of hood that it will look bulky and "mussy" when it is collapsed along the side of the cockpit, but while it is not claimed that it is as neat in appearance as is the automobile top, it is surprising into how small a space a length of stout, light canvas may be folded.

A convertible, removable, adjustable, combination sunshade and rain shelter has been devised which is particularly well suited for use on small, well-equipped, pleasure boats. This consists of a canvas top stretched over a wire frame that is supported only at its two ends by an upright stanchion set at both the bow and stern of the cockpit. These stanchions rest in sockets and consequently are easily set in place and taken out, thus forming the removable feature of this canopy.

The frame of the canvas top is attached to each stanchion by a sliding collar that can be held in any position along the upright by means of a set screw. Thus the top can be set at any desired distance above the cockpit, and as one end can be raised or lowered independently of the other, the canvas may be tilted to serve as a protection from the slanting rays of the sun.

The frame over which the canvas is stretched is set in the sliding collars by means of pins, or pivots, and thus the top may be turned around a horizontal, longitudinal axis. This allows the canopy top to be tilted sideways to serve as a spray or sun shield, or it may also be used in this manner as a protection from cold breezes. When the craft is not in use, the top may be slid down the stanchions until it rests over the coaming, and thus a substantial cockpit cover is formed that will serve well to keep rain out of the interior of the boat.

Whether a man buys a ready-made spray hood or top, or whether he makes one himself, the size and weight of the boat to which it is to be attached should always receive first consideration. A permanent canopy top, set on stout stanchions high enough above the floor to furnish ample headroom, makes one of the best covers for a twenty-five or thirty-foot boat, or larger, but it should not be fitted to a light racer or runabout on which it would be top-heavy. This precaution should not be taken so much on account of the appearance of the craft as because of the actual safety to the occupants of the boat under some conditions. In a heavy blow the wind resistance of the canopy top might easily upset the boat.

## CHAPTER VIII

### CAMPING AND CRUISING

FOR camping purposes, roominess and strength in a motor boat should not be sacrificed for speed, for the latter is the least necessary attribute of a boat intended for this use. In the "good old days," when canoes furnished the only means of water transportation for a camping trip, five miles an hour sufficed to reach our goal. If five miles an hour proved good enough then, why aren't seven or eight sufficient nowadays? We don't need to bring our business habits into our pleasures to that extent—and half of the fun of camping is the "going in."

A motor boat need not be of great weight for camping trips, and a power canoe can be obtained which will not weigh over one hundred and twenty-five pounds including hull, engine, gasoline tank, and all accessories necessary for its operation. If a good, stout skag, well braced, is attached to the stern end of the keel so that it affords ample protection for the propeller, this craft, which will not draw over fifteen inches of water, should be able to navigate almost any stream accessible to an ordinary "man-power" canoe.

The small additional weight of the motor will not interfere with the use of the canoe for ordinary paddling if the power should give out; in fact, the engine will occupy so little space that it can be ignored almost entirely and the craft used as an ordinary canoe when desired. This is a decided advantage that a light power canoe has over a bulkier craft for camping purposes when it is desired to navigate shallow and unknown streams in a necessarily slow and cautious manner.

If carries are so frequent on the proposed camping trip that even the lightest power canoe should be too heavy for convenience, a detachable motor may be obtained which may be installed quickly on almost any form of square-ended hull. The motor of this power plant is attached to a tiller and is connected with two sets of bevel gears to the propeller, which can be turned in either direction and is used to replace the rudder.

As the motor, shaft, rudder, tiller, propeller, gasoline tank, and other accessories all form a single unit, the entire power plant may be removed and carried separately across any intervening neck of land. When the boat is again launched on the other side, it may be reconverted into a power craft with only a few minutes' work.

Such a power plant may be installed on almost any small hull, but the square stern offers a more convenient shape of surface to which to attach the clamps or eyes and pins that are used to support the motor.

For camping in localities where there are no carries to be made, a larger power boat is preferable to a motor canoe, and a twenty-five-footer, when properly arranged, can be made to accommodate three or four men and all duffle and provisions for several weeks. Such a boat should have ample beam—at least six or six and a half feet—and should be equipped with built-in seats, under which lockers should be arranged.

Room in the stern for carrying equipment can be obtained by constructing the hull of the V-transom stern type, and this is in reality a speedier and more seaworthy design than any other form. For all purposes throughout the field of motor boating this type of stern has practically supplanted the fantail, torpedo, compromise, and other forms of rear-hull design. Of course this statement does not apply to the case of motor canoes and motor skiffs, in which the general lines of the hull are the same as in the man-power types, but the majority of ready-made power craft will be found to be designed with this V-transom stern.

If the hull is stanch, with no leaks, this stern compartment should be one of the driest in the whole boat, as it is entirely inclosed from the rain and spray. This, then, is the logical place in which to stow goods injured by dampness—provided the deck above is well calked so that no rain can leak through. On account of the inaccessibility of the far corners of this compartment, articles which are rarely used should be the only ones to be stowed this far back.

If the boat is equipped with a substantial canopy roof, the tent and other comparatively light articles whose weight can be distributed over a considerable space may be lashed to the top, thus saving much room in the cockpit. An open boat is really preferable for camping, however, for there will then be no top to interfere with overhanging boughs or low bridges.

I do not advise that a twenty-five-foot motor boat should entirely take the place of one or more canoes on *all* camping trips, for some sort of a tender is necessary in many places where the shore formation renders it impossible for the bulkier craft to land. A light skiff or canoe can find a landing along almost any shore and can be pulled up on a shelving rock or beach out of reach of the waves. Even a motor canoe can be handled in this manner.

Even one skiff or canoe must be towed in the proper relation with the motor boat, and when several are trailing behind, the matter of attaching all so that each will follow in the wake of the other is one which requires some experience. Every boat when under power leaves in its wake a series of stern waves which travel in the same direction and extend at right angles to the course. The problem of towing is to attach each skiff or canoe so that its bow will rest on one of these stern waves, for otherwise the craft in tow will not follow in the proper wake, but will "slew" rapidly from one side to the other and will eventually either fill with water or overturn from the jerk of the towrope.

In towing a single skiff or canoe, it may be attached within a few inches of the extreme stern of the power boat. If the power boat is traveling at high speed, however, the towline should be let out so that the bow of the skiff is resting on the second or third stern wave. In towing a series of boats, one may be attached close to the stern of the power craft, two more at the second stern wave, another two on the wave behind this, and so on.

Not more than two should be towed on the same stern wave, and a single skiff is all that should be carried close to the power boat. Men should be seated in the sterns of several of the boats in tow to keep the slack from interfering with the propeller of the motor boat when the power is shut off, and to help the long line around any sharp turns which may be in the course. Any weight in any of the skiffs in tow should be shifted to the extreme stern of the boat in order to keep the bow from drawing down.

As the field for camping is enlarged by the motor boat, so is the fitting out rendered slightly more complicated. Ignoring entirely the necessary accessories for the motor, additional paraphernalia must be taken which could be omitted were canoes alone used, but this extra equipment may prove of invaluable service and should on no account be left at home.

First and foremost of these comes the anchor, which, if it will not actually prove the means of saving the occupants from bodily harm, will probably at least save the boat from many scratches and bumps—if not more serious damage. If any distance is to be traveled over open water, two anchors should be carried, for it may become necessary to "ride out a gale" in some bay not well protected, and if one anchor should refuse to hold in this case, or if the line should part, a second "hook" may be the means of keeping the boat off a rocky shore.

Even though the camping trip is to be taken only along a small river, protected at all points from high winds or heavy seas, the anchor and cable, or rope, should be sufficiently heavy to withstand a great strain, as the motor may break down in a swift current. In this case the anchor may keep the boat from being carried on shore, and the mechanic or engineer of the party may then take his time while making repairs. Trouble with a motor cannot be located and repaired properly if there is a necessity for haste, as would be the case were the boat drifting upon the near-by shore. While in the larger boats the anchor is a heavy mass of iron which must be carried outside the hull or on the deck, small motor boats may be equipped with collapsible or folding anchors which may be stowed in a comparatively small space 'tween decks, and which will yet be ready for instant use when the occasion arises.

The most vital and vulnerable part of the exterior of a motor boat is the propeller and shaft, and even a heavy skag will not always serve to keep this from damage if a shoal, sandbar, or log is encountered. It is the care that must be taken to prevent contact of the propeller with a rock that makes landing a medium-sized motor boat on an unknown shore such a difficult operation. The bow or 'midship section of the hull may be beached, or may even be allowed to bump a rock lightly, and so, unless there is a pier or wharf at hand or some natural landing place where it is known that the water is sufficiently deep, a landing from the motor boat must be made "bow on."

In this case, a stout anchor and sufficient length of rope may sometimes be made to take the place of a tender in enabling landings to be made at places on the shore where no natural or artificial wharf or pier will be found. If the landing on this "treacherous shore" is to be made directly from the motor boat without the use of a tender, the anchor should be dropped when the craft is still a hundred feet or so from the desired point of disembarking. After the anchor has firmly caught in the river bottom, the boat may proceed very slowly toward the shore, the anchor rope being kept sufficiently taut so that the headway may be stopped immediately if the water becomes too shallow.

It is probable that the water will be sufficiently deep for the propeller a boat length away from shore; this being the case, the craft may be moved forward until the bow strikes the beach or a rock forming a suitable landing place. The anchor rope should then be made fast to its cleat so that the stern cannot drift around parallel with the shore, and by attaching a bow line to a rock or tree, the boat may be held in this position until all of the passengers and equipment are landed.

It would not be advisable to leave the boat unattended in this manner for any length of time, for if the anchor should be dragged only a few feet by the wind or the current, the hull would probably be damaged by being bumped against the rocks from which it was formerly held away by the anchor rope. To tether a boat so that it will be kept at a safe distance from the shore and yet rendered accessible when desired is a problem which can best be solved by employing a tender; the use of the anchor for this purpose is only a makeshift for a temporary landing.

If the route to be traversed is through unknown waters—streams, bays, and lakes abounding in shoals and sandbars of which there are no Government maps or charts obtainable—a small hand capstan, firmly secured to the bow or stern deck, may prove an invaluable addition to the camping equipment. The capstan on larger boats is a sort of windlass used for raising the anchor, but on the smaller craft its services may be reversed.

This will be the case if the boat has stuck on a sandbar or shoal in such a manner that it can neither be moved by its own power nor lifted off by the members of the party. In this event, the anchor may be carried out in the tender to deeper water and firmly imbedded in the bottom. By then operating the capstan attached to the anchor rope, a tremendous pull will be exerted on the boat, which should serve to move it off into the deeper water.

Although a heavy skag is a great protection to the propeller, a sunken log or peculiarly-shaped rock may take one or two "buckets" off the wheel in spite of all precautions. I therefore advise every camper who uses a motor boat to be as certain to carry along an extra wheel or buckets as he is sure to make his pipe and tobacco a part of the equipment; he can borrow a smoke from his friends, but they won't have any propeller blades concealed about their clothes.

But even though an extra wheel or so is available in case of accident to the old one, how is the change to be made, with the nearest boathouse or derrick miles away? If the boat is a light one, the solution is easy, for a shelving beach, a large, round log, and two or three husky men can bring the stern out of water in a "jiffy." But the problem is not so simple in the case of a boat weighing two or three tons, or more, and the camper must call on mechanical means to aid him.

These will be furnished if he has been wise enough to carry in the boat as a part of his regular equipment on such a camping expedition a differential pulley, or what is more commonly known as an "endless chain." This consists of but three parts—the chain, a single lower pulley, and a double upper pulley. A hook fastened to the bearing of the double pulley enables it to be suspended from any stout overhead support, while a similar hook on the lower pulley is attached to a rope passed around the hull of the boat to be raised.

By pulling one side of the chain the lower pulley and hook will be raised, slowly to be sure, but with sufficient force to lift from one to ten tons, depending upon the capacity and size of the equipment. By pulling the other side of the chain the weight will be lowered easily and gently. The principal feature of this arrangement is that the weight will remain suspended at any height at which it is left, without the necessity of fastening the chain. In other words, the pulley is "self-locking."

Although the wheels and chain of this differential pulley are rather heavy, the whole arrangement may be stowed in a comparatively small space, and, considering the service that this may render to the boat and party, the added weight may well be deemed inconsequential. The chief difficulty to be encountered on a long trip when it is desired to use this pulley is to find a place over the water from which to suspend the upper block. A launch slip in a boathouse having stout overhead rafters will, of course, offer an easy solution, but when on a trip during which boathouses are few and far between, a pier or bridge under which there is sufficient water to run the boat can be made to serve the purpose.

In case the country is so unsettled that even rude bridges will be scarce, a projecting rock ledge or stout limb of a tree, a couple of heavy logs, and a little of that ingenuity with which every camper is supposed to be endowed should combine to make possible a repair to the propeller under almost any conditions.

No camping trip in a motor boat should be undertaken without carrying along a plentiful supply of old but serviceable fenders to protect the side of the boat from scratches and bumps while making landings. It is a good idea to attach small brass cleats at frequent intervals along the gunwales on both sides of the hull, so that a fender can be fastened immediately to almost any portion of the boat. Old leather boat cushions that have been considered worn out long ago will be found to make serviceable fenders in lieu of the ordinary cork-filled kind.

If the campers carry along a tent to protect them from rain and dampness, why should not the faithful little boat and engine that have brought them to this Nirvana be accorded the same consideration? A stout duck cover made to fit over the cockpit by means of rings and eyes, and raised in the center by a pole placed lengthwise across the cockpit as described in a preceding chapter, will serve to keep the interior and the motor dry and in good condition, and the little craft will be much more willing to continue the journey indefinitely than would be the case were it exposed to all kinds of weather.

Motor boat cruising need not be restricted to a large cruiser. In fact, some of the most enjoyable trips, lasting several days or weeks, may be taken in an ordinary open motor boat, and almost as much pleasure and comfort will be had as though the craft were especially designed for such a purpose. Few men are fortunate enough to possess two motor boats of different types, and for the average owner the twenty-five or thirty-foot open craft will suit his all-around needs much better than will a bona fide cruiser.

The latter is not as well adapted for use as a pleasure or sight-seeing craft as is the open boat, from which an unobstructed view may be had in all directions, and the deck space of the cruiser is too limited for a short, daylight trip on which the occupants desire to be out of doors as much as possible. To be sure, the enclosed cabin of the cruiser is ideal for stormy weather and for sleeping on board, but the open boat may be made snug and comfortable by the use of a little ingenuity and a few attachments that may be easily and quickly obtained and applied.

It is to be assumed, of course, that the open craft in question will consist of a stout hull and a sturdy, reliable motor, and consequently the considerations of the transformation of this into a cruiser will consist of attachments or changes that do not affect the general design of the boat as a whole. By an open boat is meant one in which the cockpit is not enclosed at the sides, as is the case with the cruiser, but a top of some kind is necessary on any craft in which the party is to live for any length of time. Many open boats are supplied with some sort of a canopy top for shelter from the sun and rain, and some of these are of the detachable type such as is used on automobiles.

The automobile top, however, is not suitable for more than a few days' cruise, as it is seldom that sufficient headroom will be found under it to render the interior of the boat comfortable when entirely enclosed. Furthermore, it is hardly strong or substantial enough to withstand a heavy gale, and while it is ideal for short trips along protected waters, a more permanent arrangement is necessary for an extended cruise on which all manner of conditions will be met.

The most substantial form of permanent canopy top has been already described. Stout curtains of some waterproof material should be attached to the underside of the canopy along its outside edge. There should be several sections of these of such a width that they will overlap a few inches at the stanchions. These curtains should be buttoned to each other at the overlapping edges and should be fastened to the lower, outside edge of the coaming, near the deck, by means of hooks and grommets, or brass rings, worked into the cloth.

The curtains may be rolled up under the canopy when not in use and held in place by short leather straps and hooks. Any or all portions of the cockpit may be enclosed, and a protecting section of the curtain will be found exceedingly useful, even on a fair day, when a quartering wind blows the spray into the interior of the boat, or when a member of the party complains of a "draft" at the back of his neck.

There can be no portholes with glass windows in such a cabin, but pieces of thin sheet celluloid sewed into holes cut in the curtains make an excellent substitute, and one of these at the bow in front of the wheel will allow the boat to be navigated in the stormiest weather with the cockpit entirely enclosed and the pilot as snug and well protected as any other member of the party. When the boat is under way it will seldom be necessary to button down all of the curtains, for a part of the cockpit will be in the lee of the wind and this side may be left open.

While the boat is occupied it is necessary to leave at least a part of one curtain open for ventilation, for the air will soon become unbearably close if the cockpit is entirely enclosed. Consequently it is only when the boat is left unattended that the curtains will be buttoned down tightly on all sides.

This substantial canopy has another advantage over the automobile top for cruising, in that hooks may be screwed in the cross-pieces and stanchions of the former and almost any section of the cockpit converted into a wardrobe at night. If the cruise is to be taken during the mosquito, fly, or "punkie" season, plenty of mosquito netting should be taken along to be pinned over the loose flaps of the curtains that are left open at night for purposes of ventilation.

In the small open cockpit of a boat of this size, a portable heater would not only be impracticable, but unnecessary as well. Anyone who has had any experience with a motor boat will realize that the engine, although cooled by a constant supply of water, gives off a considerable amount of heat when running and for some time after it has stopped. With most of the curtains closed, this heat from the motor can be confined and will make the interior of the boat several degrees warmer than the temperature of the outside air.

On an unusually cold night, the clutch may be disconnected or the blades thrown to neutral, and the motor may then be used as a heat generator as often as necessary. The motor is more efficient for this purpose in the open boat with the curtains closed than it is in the cruiser, for in the latter case, the power plant is generally located in a separate compartment and a large amount of its heat would not reach the main cabin.

The sleeping arrangements in an open boat cannot, of course, be made as compact as those of a cruiser; the back of the side seats cannot be pulled up to form an upper berth and there can be no owner's private stateroom provided. It is possible, however, for two or three to sleep comfortably aboard a twenty-five foot boat, not originally designed for cruising, on beds which, while not the softest or springiest, will at least be restful and can be stowed in a small space in one of the lockers when not in use.

The construction of such a bed is one of the things requiring a small amount of that ingenuity necessary to convert an ordinary open boat into a cruiser, which is half the fun of preparing for such a trip. Inasmuch as the interior arrangement of the cockpit of different boats will vary to a great extent, no definite directions for making a collapsible bed can be given, but the description of an average case taken as an example may help the novice the better to plan for such a cruise.

Suppose, for instance, you have a twenty-five foot open boat of goodly beam with the motor located about amidships. It is probable that the lockers and seats will extend along the sides of the interior and around the stern, thus leaving a considerable unoccupied floor space aft of the motor. You will immediately recognize this as the logical place for the erection of a double bed so as to utilize the side and stern locker seats.

This can best be done by constructing a framework and platform to fit this space between the seats aft of the motor, and you will then have a bed probably six or seven feet long and at least five feet wide. The framework for this platform need consist of but two long sticks placed alongside the lockers and supported by three or four hinged, inverted, V-shaped pieces. If the legs of these pieces are held at the proper distance apart when in use by means of hooks and eyes, the supports may be folded together in compact form when you desire to stow the bed in the daytime. It will be an easy matter for you to get several boards and shape their edges to fit different sections of the space between the lockers, and if you place cleats along these boards at the proper places, they will be held rigidly in position on the framework.

For a different location of the motor, you will need to follow a different design of bed, or platform, but in any event the sleeping quarters should be raised well above the floor of the cockpit in order to obtain all the fresh air possible. It must be remembered that there can never be a perfect circulation of air in the cockpit several feet below the coaming and that it is here that any gasoline vapors will collect. Consequently do not think that cushions spread on the floor of the craft will serve as a satisfactory bed for a night or so—the double bed formed by the platform is worth all the trouble required to make it, even for a single night's lodging.

Of course, the open boat cannot be provided with a complete galley, but by using one of the lockers as a storeroom for provisions and carrying along a gasoline or kerosene stove such as is used on the cruisers, meals "fit for a king" may be prepared with remarkably little trouble. The "trimmings," such as tablecloth, napkins, and finger bowls will be missing, but on a cruise the lack of such equipment will probably be considered more of a luxury than a hardship. When in use, the stove may be placed on a hinged shelf in one corner of the cockpit. The shelf should be installed at such a height that the burner of the stove will come a few inches below the coaming, and the flame will thus be protected from the wind on two sides.

In case the wind is blowing on the unprotected side of the stove, a piece of canvas, or a curtain, may be rigged up where necessary, and in this manner a snug little galley may be improvised. There will be times, however, when the stove cannot be used on shipboard on account of a heavy sea or high wind; in either of these events, the appetites of the party must be appeased with the ready-cooked canned goods which should form a part of the commissary department of every cruise.

Extra propeller blades, or an entire wheel, should form a part of every cruising equipment, even though the trip is to be taken over "familiar ground"—and in the event of the latter proving literally true, an extra "bucket" or two may be the only means by which the outing may be continued as originally planned. If the trip is to be through large, navigable rivers and deep lakes, and care is taken to keep away from the shore, an accident to the propeller is not probable, but a submerged log or a floating piece of wreckage may easily accomplish what the absence of sand bars or shoals would seem to render impossible.

# CHAPTER IX

## THE BOATHOUSE

EVERY motor boat, no matter how small or cheap, deserves a home of some kind where it may be sheltered from the rain and dew. This need not be an elaborate or expensive structure, nor, in fact, is it necessary that it should be a building at all, for a sloping canvas roof will serve as effectually to keep out the dampness as will one made of timbers and shingles or tile.

The man who already owns a motor boat, skiff, canoe, or sailboat will probably have some form of dock or landing stage projecting into the river or lake. If this dock is in the form of an uncovered slip between the piers of which the craft may be run, the construction of a simple shelter is an easy matter. This will consist of a strip of heavy canvas stretched over iron bows, or hoops, that straddle the slip. In order to make a substantial framework, one of these hoops should be set in the slip at a distance of about every three feet, and each may be held securely in place by means of sockets into which the ends slide.

Screw rings, or eyes, should be attached to the sides of the slip above the sockets to serve as guides, and if the sockets are provided with stops for the ends of the hoops, no clamps will be needed to hold the framework in place. The hoops should be sufficiently long so that the heads of occupants of the boat will not strike the top of the framework at high water, although if this distance is made unnecessarily great, an undue amount of canvas will be required and the cost of the shelter will not be kept as low as would otherwise be the case.

The canvas should be sufficiently wide to surround the hoops completely from one side to the other where they project above the docks. The edges of the canvas may be either laced or hooked down to the top of the docks or sides of the slip, and for this purpose, grommets, or brass rings, should be sewed into the material. The covering may be attached to the hoops either by lacing or by means of sliding rings sewed into the canvas, but as the latter permits the shelter to be raised along the side when it is desired to admit more light or air, this is probably the better method of the two. Flaps should be provided at both the water and shore ends of this "tunnel," and these should be furnished with lacing or buttons that will render them rain and wind tight when closed.

If wide docks form the slip over which the shelter is erected, entrances may be cut in the canvas on either side of the covering. These should be in the form of flaps between two of the hoops, and the loose canvas may be buttoned or laced down when it is desired to "close the doors." Such a side flap is useful for entering or leaving the boat, for there is no dock space provided inside of the canvas covering.

If there is no uncovered slip over which this canvas shelter may be erected, and if the only landing consists of a dock that juts into the water a sufficient distance, an additional pier will need to be constructed. This, however, need not dampen the ambitions of the man who desires to erect a shelter for his boat, as the building of a small pier is not as complicated or serious an undertaking as it may sound. The pier need only serve the purpose of furnishing a substantial anchorage for the other end of the hoops forming the framework for the canvas, and it is not even necessary that a platform be built along the top, as the entrance to and exit from the boat would be made from the dock side.

If the river or lake bottom is sufficiently soft, the simplest pier would be formed of a line of piles driven into the mud and a heavy timber laid across the top and secured to each one. The guides and sockets for the hoops could then be attached to the timber and the proper piles, respectively.

If the river bottom is too rocky to enable piles to be driven in, "cribs" should be built on the bottom of posts of the proper length. These posts may then be placed in position to form the pier, and if the cribs at their ends are loaded with stones and the tops secured to the heavy timber as already described, the resulting structure will be sufficiently well anchored to form a solid support for the canvas framework and covering.

Many boathouses are constructed with docks on all sides, and in this case, such a landing stage may be used in connection with the above-mentioned pier to form a canvas-covered shelter for an extra motor boat. If there are no docks along the sides of the boathouse, or if the water is not sufficiently deep for the accommodation of a motor boat, two pile-piers may be built out from the front of the building and the slip thus formed may then be covered with the canvas shelter.

This is a simple method of providing for the accommodation of more craft than the boathouse is capable of holding, but the objection will at once be raised that the shelter includes no dock alongside of which landings may be made. This, of course, is true, but if a small platform is built across a bow corner of the slip from the shore end of a pier to the boathouse, entrance to the craft may be effected from the forward deck. If the boathouse was designed for the accommodation of skiffs or canoes only and consequently is floored over completely inside, it will be well to build the covered slip for the motor boat directly out from the water-front door and thus do away with the necessity of constructing an outside dock or platform.

A motor boat is a necessary adjunct to every house boat, for not only will it act in the capacity of messenger between this water residence and a base of supplies, but it may also serve as the motive power for towing the larger craft from one resting place to another. This nomadic existence of such a motor boat renders the problem of its proper shelter rather a serious one, and oftentimes a cockpit cover forms the only protection that the craft will find for an entire season. If a house boat can be towed from place to place, however, there is no reason why a boathouse having such transient properties might not also be constructed.

Such a floating shelter may consist of a canvas covering and framework such as has already been described, but instead of mounting the iron hoops on permanent piers, a special construction is required. The simplest form of floating support for the framework is composed of a sufficient number of watertight barrels or kegs held together in two parallel lines by heavy timbers attached to each. These two lines should be braced at their forward ends with an extra timber so that they will be kept at the proper distance apart, and as an added precaution, the stern hoop should be made especially heavy to help maintain this position.

There are many substantial boathouses built with a "solid floor" for the accommodation of skiffs or canoes, and it may be that some of these, on account of their construction, cannot be converted into motor boat garages. A shelter for the boat, however, that is more substantial and permanent than the canvas covering, may be added to such a boathouse at small expense in the form of a "lean-to." Such a lean-to, of course, cannot afford a great amount of interior space, but as it is intended to serve merely as a permanent shelter for the boat, a slip large enough to accommodate the craft will furnish all of the room necessary. A dock should be built out from the shore parallel with the side of the boathouse and at a distance from it equal to the width of the desired slip. The roof over this slip may be a continuation of that over the main boathouse, at a decreased angle, if necessary, to allow the proper amount of head room. The rafters may be attached to the projecting eaves of the main roof and supported at the other end by the siding that should be erected on the dock built for the purpose.

If the dock has been built wide enough, it is well to erect this siding on the center line so that there will be platform space both inside and outside the lean-to. Otherwise, it is probable that the dock will be more useful outside as a landing place than it will inside of the lean-to, as the floor space of the main boathouse will serve all interior platform purposes. One or more doors should be cut through the old boathouse partition against which the lean-to is built. It is obvious that such an addition to a boathouse is suitable only for the accommodation of open motor boats, as there would not be sufficient ceiling space afforded for those having permanent canopy tops or cabins.

Even though the black flag was long ago hauled down, the motor boat owner realizes that piracy exists to a greater or less degree along our waterways and at the summer resorts where a set of batteries, easily-"borrowed" tools, expensive cork-filled cushions, and even gasoline and lubricating oil that lie in unguarded craft make profitable loot for these modern, though petty, buccaneers. A canvas covering may protect the cockpit of the boat from rain and dew, but it cannot guard the contents from the covetously-inclined prowler, and the owner who erects a boathouse in which his craft may be kept under lock and key will be able to pay more than interest on his investment by the saving on his battery and spark plug bills alone. But it is not only the owner who has suffered losses of the movable property of his boat who will profit by housing his craft in a substantial building; a well-designed boathouse is of great convenience in other respects, and as a storehouse in winter and a repair shop in summer it is a "*multum in parvo*" of no mean consideration.

As the enthusiast who has graduated from skiff, canoe, or sailboat to motor boat has made the change by degrees, so it is probable that he will not care to bear the expense of a brand-new motor boat garage as a matriculation fee. This is not necessary, however, for with his old skiffhouse or canoe shed as a nucleus, the owner may evolve a habitation for his craft that will be in keeping with his progression as a nautical sportsman. This, of course, does not apply to the man who, as a first venture, invests in a forty-footer, but is directed only to the owner whose purchase is a runabout no longer than an ordinary-sized boathouse.

If the original boathouse sets out from shore a sufficient distance, the water under its floor will be deep enough for the accommodation of the small motor boat, and the planking need only be cut away to form a slip. The beams on which the floor rests will, of course, need to be rearranged, and it is possible that an extra pier or two will be required at the sides of this new slip for the support of the stringpieces.

If the boathouse rests on but four piers—one at each corner—it will be an easy matter to cut a slip, as there will then be no obstruction at its entrance. A third pier at the front of the boathouse, however, will seriously interfere with the construction of a central slip and may need to be replaced with two small ones—thus forming two piers at each side of the entrance.

As three piers at the front would probably only be used to support a moderately large boathouse, it would be well to cut the slip between two of these piers and thus preserve the remaining half of the floor space intact if the boat to be accommodated is a small one. It should always be remembered, however, that a "tight fit" between boat and slip is inadvisable and that the latter should always be several feet wider than the beam of the craft it is to receive. Consequently, it may be necessary to remove the central pier in order to construct a slip that will be sufficiently wide.

If the boathouse does not set far enough out from shore to afford a sufficient depth of water when the slip is cut in the floor, the nature of the bottom will determine the advisability of dredging or moving the building. Even though a small boat will not draw over two or three feet of water, provision should be made for a variation in the level of the surface of the stream or lake on which the boathouse is situated, and a depth of five or six feet under the stern is none too great for the accommodation of an ordinary craft. If the bottom is soft, it will, of course, be an easy matter to dredge the slip to the desired depth, but the action of the waves will probably soon refill the excavation and make it necessary to repeat the operation several times in a season.

Whether cruiser or racer is ultimately purchased, the services of the little runabout will always be needed, and it is well to provide for the accommodation of one of the latter as a first consideration and basis of the boathouse plans. Such a slip should be at least twenty feet long and five feet wide, even though the runabout owned at present should be considerably smaller than these dimensions. The main portion of the boathouse should be devoted to the provisions for accommodating the prospective larger craft, while the slip for the runabout may be placed in a connecting lean-to formed by an extension of the roof at an angle different from that at which it slopes on the other side. As it is not beyond the bounds of probability that a forty-foot racer or cruiser will be the "ultimate purchase," it is well to build the main portion of the house at least fifty feet long. The large slip can be covered over with planks which have been cut to fit into it and rest on cleats secured to the sides. This will form a smooth, level floor which can be taken up as soon as it is desired to use the slip. If the slip is not cut when the house is built, provision should be made for this to be done at any time by so locating the piers that none will be placed directly at the entrance when the floor is reconstructed.

A boathouse designed to accommodate a large "fleet," from yacht or cruiser down to a small runabout or tender, should be built with the largest slip in the center under the peak of the roof and those of the successively smaller sizes on either side so that the individual slips for the "youngsters" are under the eaves. This design is necessary on account of the practice of using tall signal masts on yachts and large cruisers.

There should be plenty of floor space between the slips and the entire building should extend several feet beyond the end of the longest. Rather than build the slips at the sides of just the size to accommodate the small boats, and thus restrict their capacity, it is better to construct one or two larger slips and in these keep all the runabouts, work boats, and tenders not sufficiently large to require an individual slip. This will thus furnish an emergency or "guest" slip.

Boats equipped with signal masts require all of the available roof space, of course, and it is consequently impossible to build a loft in the boathouse. If it is certain that a boat of this size or type will never be purchased, however, it is well to design the boathouse with a loft. This is not only useful as an extra room for the storage of spare equipment, tops, fenders, chairs, canvas, rope, and the like, but the interposition of this top flooring between the boat and the roof protects the hull from being unduly dried out during the hot days of spring before the craft is made ready for the water.

When the piers for the boathouse are built, it is well to make these considerably larger than is necessary for the support of the building alone, and use the foundation thus afforded for the construction of ample and substantial docks. A boathouse with no outside docks is as poorly designed as a country home with no porch. In fact, docks should be built, not only on both sides of the boathouse, but in front as well, and the motor boat garage having the greatest amount of "wharfage" is, in some respects, the best designed. Plenty of dock space not only affords accommodation for visiting craft and lends an air of hospitality to the water front, but the owner will find every square foot of it useful at various times for his own boat.

If the boat has been running in a heavy sea or a severe storm, the interior, top, curtains, and the like may be dried to much better advantage if the craft is left outside where sun and wind will help the process. Then, too, in making repairs to the motor or painting a part of the hull or top, it may be advisable to move the boat out where sun, air, and light will be more abundant, and then the dock on the side on which the conditions are the most favorable may be selected,—and the advantage of having a choice will be appreciated.

Even in the strongest wind, the boathouse may prove itself a substantial shelter and breakwater and the dock on the lee side will afford a safe refuge when it would be impossible to land at the opposite platform on account of the high seas. A large amount of dock space that will be sheltered from almost any wind that blows can be obtained by building a "basin" or open slip parallel with the shore line and at a sufficient distance from it to afford the proper depth of water. This basin should be built large enough to receive several small boats, and the outside of the large pier which serves as a breakwater may be used for the accommodation of a long craft.

By using the platform at one side of the boathouse to form the end of the slip, but one or two additional docks need be built for the construction of this sheltered basin and the maximum amount of water frontage is thus obtained on a comparatively short shore line and at a minimum cost. The construction of the dock forming the land side of the slip should not be difficult, as one end of the cross floor beams may rest on shore while the other end can be supported on piles or piers built only far enough out to obtain a sufficient depth of water. When one or more such slips are covered over with a well-designed shingle or tile roof, an attractive "guest shelter" is provided that may even serve as a temporary accommodation for the owner's boat.

Small platforms at the front of the boathouse between the slip entrances may often be used to good advantage for small boats or for reaching the stern of the craft inside, and as they require no extra piers, but can be supported by those forming the foundation of the boathouse, the expense involved is almost negligible. If the boat occupying the slip is rather a "tight fit" and there is not sufficient room to allow for erratic steering or a slight miscalculation on the part of the pilot, it is well to cut off the corners of the outside docks guarding the entrance. The docks on either side of the slip will then act as a sort of guide that will enable the boat to enter its berth with ease.

No matter how simple or how elaborate may be the construction of the boathouse, precautions will need to be taken against the devastations of winter if the structure is located on a stream or body of water on which ice forms every year. Ice and high water show no favors, and many a man has returned to his summer home the following year only to find his boathouse tilted up at one corner and down at the other and the position of the front piers changed so that the doors to the slip cannot be opened. The weakest point of the foundation of the boathouse, and at the same time the one most open to the attack of the ice, is the forward line of piers separating the slips. These cannot be strung together with heavy crosspieces, as is the case with those supporting the floor, and in consequence the ice is liable to move the forward piers independently of the boathouse.

To provide against this, the end piers should be tied together when the boathouse is closed for the winter, and this is best done by the use of two heavy rods joined at the ends by means of a turn-buckle. The outer ends of the rods should be in the form of hooks which are to fit into eyes screwed into the heavy timbers of each pier. The eyes should have been so placed that the tie rod will come about level with the surface of the water, and after this has been hooked in place, it should be tightened with the turn-buckle. If such a rod is placed across the end of each slip, the piers cannot move away from each other and the boathouse will be found in much better shape than would be the case were the ice and high water allowed to have full sway.

Notwithstanding the damage that may result if care is not taken, it may be said that every motor boat should be hauled out of the water at least once each year, even though it is desired to use the craft throughout the whole twelve months. On northern waters, where the severe winters form ice that would be almost certain to crush or scratch the hull of a comparatively small boat, the reason for hauling the craft out of the reach of harm from this source is apparent; and anyone who has seen large piers or boathouses twisted or moved bodily from their foundations will realize the small chance that a frail hull would have of withstanding this tremendous force of the frozen water. But every boat, whether used in waters where ice is to be reckoned with or not, requires painting on the under-water portions of the hull at least once or twice a year; and in tropical or semitropical streams where barnacles and marine growth are more abundant, it may be found necessary to haul the craft out of water once every two or three months in order to obtain the best results.

Were the hull not painted, the wood of which it is composed would soon become water-soaked and practically useless. The paint, then, serves to prevent the water from entering the porous fibers of the wood, and keeps the hull dry and at its minimum weight. The length of life of paint on wood under water is not great, however, and while some of the largest steamers and sailboats may not seek the dry dock for several years, this is because of the expense, labor, and time required for such an operation, and a light motor boat that can be hauled out of water in a few hours, or minutes, has no excuse for remaining unpainted any longer than is necessary.

It is due to these three reasons, then—danger from ice, the necessity for painting, and the fact that the longer the hull is left in the water the more water will it absorb—that the average motor boat should be hauled out high and dry for its winter's rest. If the boat is a light affair, such as a motor canoe or skiff, it may be lifted out of the water and set on sawhorses. Several sticks nailed to the floor and wedged under the gunwales at each side will serve to keep the boat from tipping over, and are as effective for this work as the more elaborate bilge blocks. If the floor space of the boathouse is desired for other purposes, the boat may be suspended from the rafters by means of several ropes passed entirely around the hull. One of these should be placed under the motor, and the greatest weight should rest here in order to prevent the keel from sagging. Such a method of leaving a small motor boat for the winter, however, is hardly advisable, as the ropes are liable to slip a little or stretch, and thus change the distribution of the weight and allow the strain to come on some vital part of the hull.

Larger boats should be raised from the slip cut for their accommodation in the boathouse floor. If the boathouse is well equipped, it is probable that the slip will be provided with two or three sets of vertical screws, to the lower ends of each pair of which are attached heavy timbers which will be raised as the nuts on the screws are turned. A powerful lifting force can be obtained in this manner, and the boat can be raised carefully and easily to the desired distance above the water. If the height of the water remains constant throughout the winter, or recedes slightly, the boat need be raised only until the keel is a few inches above the surface. In fact, it would be better to leave the keel and extreme bottom of the hull submerged until freezing weather settles down, but this, of course, can only be done if there is a man near at hand who can be trusted to raise the boat high and dry as soon as winter makes its appearance.

The screws should be so spaced that the weight of the motor of the boat will come directly over one of the timbers. In raising the craft, the timber carrying this greatest weight should be kept slightly in advance of the other screws so that it may be certain that an unsupported keel is not carrying the entire weight of the motor. When the boat has been raised to the desired height, the other timbers may be screwed up to a position that will perceptibly relieve the weight on the first screw, but this latter should still be carrying the greatest part of the load, so that there can be no possibility that the weight of the motor will cause the keel to sag.

If the boathouse slip is not equipped with these screws and timbers, the differential pulley may be of use in raising the boat out of water. Two heavy timbers to which the pulley may be attached should be erected over the bow and stern of the boat and supported by stout uprights. If the floor of the boathouse is not too high above the surface of the water, the stern may be raised first, a long timber placed under the keel with its ends resting on the floor at either side of the slip, and this half of the hull may be kept out of water while the pulley is changed to the bow end. Another timber placed across the slip under the bow, and a third amidships, should furnish ample support for any boat up to thirty-five feet in length, and the craft will remain well above the reach of the water.

A couple of large, one-piece bilge blocks, cut to fit the curvature of the sides of the hull at the points at which they would be used for support, will be found to be much more satisfactory than the odds and ends of timber generally used. If the patterns from which the hull of the boat was constructed are available, it will be an easy matter to obtain the exact curve of all parts of the hull and to select the proper shape for the portion at which it is desired to use the bilge blocks. A heavy bilge block will need to be cut in sections, and after the proper curvature has been given to each part, the separate sections should be bolted together. The one-piece bilge blocks possess the advantage of fitting the curve of the hull exactly at the point at which the support is desired, and consequently the planking will be saved many scratches and digs. In addition to this, they are much easier to handle, and are always ready.

The fall is not the time for overhauling or repairing the motor or hull, as the long period of idleness following would render a thorough inspection necessary in the spring—and probably half of the work would need to be done over again. Consequently, the object in "preparing the boat for its winter's rest" is to leave it in such shape that deterioration will not occur, and to reduce to a minimum the necessity for repairs in the spring. This being the case, there is very little that needs to be done to the motor or to the interior of the hull. The lockers should be opened and the covers of the seats removed to allow a circulation of air and to dry out the dampness that will have collected during the summer.

While it is not probable that a few gallons of gasoline remaining in the tank would do any real harm, all fuel should be removed from the boat in order to make "assurance doubly sure." In addition to this, in case of fire and there is any difficulty with the insurance companies, it is better to be able to furnish proof positive that not a drop of gasoline was left in the boat or boathouse. The coils should be left in a dry place, but it will be useless to try to save the dry batteries, no matter how strong they may be, as they deteriorate so rapidly that they would be absolutely worthless for ignition purposes the next spring.

If a storage battery is used, it should be "run down" and then charged to its full capacity, in which condition it should be left in some place where there is no possibility of the temperature dropping below the freezing point. It is not necessary to drain the oil out of the oil cups or crank case of the motor, but there should be no oily waste or rags left in the boat or boathouse. All unplated or unpainted iron or steel parts of the motor should be thoroughly covered with "dope," or cup grease, to prevent rust, and it would not be amiss to treat the exposed rudder chains or steel cable in the same manner.

Although the boat is supposed to be left in such a condition that the keel cannot be sprung out of line, a slight settling of one of the piers of the boathouse, or poor judgment on the part of the man who superintended the raising of the hull, may leave an uneven distribution of weight on the supporting timbers. For this reason, it is a good idea to uncouple the propeller shaft from the motor and slide it back a few inches so that it will be free to occupy any position made necessary by the springing of the keel. This precaution is, of course, unnecessary if a universal coupling is used between the shaft and the motor, but it should be done in every case in which the connection is solid.

The best way to haul up on shore is to use the old, familiar " ways," if the boat is too large to be lifted by five or six men. A light boat can, of course, be picked up and carried to the place prepared for it, but the heavier craft must be pulled up over the greased timbers by means of a windlass anchored to the shore. The ways consists merely of a track of heavy timbers, running from the point at which it is desired to store the boat out into the water to a sufficient depth so that the craft may be floated over the submerged ends.

A framework designed to fit the bottom of the hull, is run out to the end of the ways, and the boat placed in position over it. This forms what is known as the " cradle," and with the keel of the boat resting on three or four heavy, supporting timbers of this framework, and with the " bilge blocks " placed in position to prevent tipping to either side, the craft may be pulled out high and dry, without any part coming into sliding contact with the timbers of the ways or cradle. The " bilge blocks " may be wooden blocks or the short ends of heavy timbers, built up to follow the curvature of the side of the hull so that the strain of keeping the boat in an upright position will be distributed along several vertical sections of the bottom.

When the boat has been hauled up to its final position it should be supported by extra timbers under its keel and at the sides, and every precaution taken to render it damage-proof against the highest gales that blow. The craft should then be covered entirely with a protection of some sort to keep out the rain or snow. Even though the boat is of the cabin variety, and the interior can be closed tightly by means of the hatchways and ports, or windows, it is advisable to board over the entire hull, decks, and cabin. Many men will merely stretch a canvas over the cockpit to keep the water from the inside, but the decks and exterior of the hull can be injured by ice, rain, and a hot sun almost as easily as can the interior. While it is not absolutely necessary to cover every portion of the hull, wet weather, followed by the hot sun of the Indian summer or early spring, may serve to dry out the planking or open up the seams, and consequently, if possible, it is advisable to inclose every part of the craft during the winter, even though considerable more time and labor will be required.

One of the easiest ways to cover the boat entirely is to board it in with rough planks, and over these to nail tarred paper. This should effectually serve to keep out both the sun and rain, and the boards, after having once been sawed to the proper length, will be available for use during successive winters. A framework, over which is stretched waterproof canvas, is sometimes used, and is effective if the "ridgepole" is placed at a sufficient distance above the deck to slant the roof enough to allow all water to run off easily. It is probable, however, that this canvas would cost almost as much as the rough boards, and the resulting covering is not as substantial as the one first described.

A boat which has been properly stored for the winter will last three times as long and will require but one half the attention in the spring as will a craft that is carelessly hauled up and left but scantily protected from the ice, rain, and sun. Remember that every hour spent in carefully laying up the boat means the saving of at least two hours in the spring, as well as a smaller bill for repairs and supplies when "fitting out time" comes.

## GLOSSARY

ACETYLENE—The gas generated by the action of water on calcium carbide. Largely used for illuminating purposes on motor boats and automobiles.

AMPERE—The electrical measure of current quantity.

ANNEAL—A heat-treating process given to iron and steel in order to obtain a uniform strcture of material.

APRON—The front curtain of an automobile type of top.

AUTO-BOAT—A name sometimes given to that type of motor-boat having its power plant located under the forward deck.

AXIS—The imaginary line about which a body may be revolved.

BABBIT—A white composition metal, easily melted, that is frequently used for bearings.

BACK-FIRE—An explosion that takes place in a gasoline engine when the valves or ports are still open. Instead of confining this explosion in the cylinder, the gases are blown through the carburetor or into the crank case.

Base—That portion of the motor to which the cylinders are bolted. Sometimes used as synonymous with crank case.

Battery (Dry)—A chemical electric current generator in which no liquids of any sort are used.

Battery (Storage)—A cell in which electric current can be stored to be used at will.

Beam—The measurement of a hull from side to side taken at its widest point.

Bearing—The metal parts in which a shaft or crank turns.

Bed—The foundation (generally of wood) on which the engine is installed.

Bilge Block—Blocks placed against the planking to support the hull when it is out of water.

Bilge Pump—A pump for removing the water from the bottom of a boat.

Bore—The measurement of the diameter of the inside of the cylinder. Also, approximately, the diameter of the top of the piston.

Bow—The extreme forward portion of a boat. As an adjective, it signifies anything forward of the amidship section.

Bronze—A copper alloy used as a material for gears, bushings and bearings.

Bucket—A term generally applied to the removable blade of a reversible propeller.

Bushing—A metal sleeve inserted as a lining in a bearing to take up wear.

Cam—An irregularly-shaped or slotted piece of metal used to convert rotary motion into lateral movement. Used in four-cycle motors for lifting the valves.

Capstan—A form of windlass, or winch, used for raising the anchor.

Carbide (Calcium Carbide)—The chemical used in the generation of acetylene gas.

Carbon—One of the chemical elements appearing in a variety of forms. Soot is practically pure carbon, as is also the hardened residue from the lubricating oil found in engine cylinders.

Carburetor—The device for mixing with the gasoline vapor the proper quantity of air for producing an easily-ignited charge in the cylinder.

Caulk—To wedge the seams, or cracks, between the planking of a boat.

Cell—A battery of either the dry, wet, or storage type.

Cleat—A metal or wooden piece having projections around which a line may be made fast.

Clutch—A connection for transmitting power from one revolving shaft to another.

Clutch (Reverse)—An attachment by means of which the propeller may be turned backward while the motor is still revolving in its forward direction.

Cock—A valve which may be opened or closed at will. Usually provided between the interior of the cylinder and the outside air for the purpose of relieving compression in the cylinder.

Cockpit—The open space or unenclosed portion of a boat.

Coil—The electrical instrument by means of which the low voltage of the batteries is raised to the high voltage necessary for the formation of the spark.

Compression—The resistance offered to the upward movement of the piston when all openings are closed. In order to obtain the full value from the ignition of the charge, the mixture must first be compressed.

Connecting Rod—The metal rod attached at one end to the piston and at the other to the crank. The means of transforming reciprocating motion into rotary movement.

CONTACT POINT—The small platinum pieces used on a coil and between which the vibrator operates as it alternately makes and breaks the circuit.

COUNTERSINK—To enlarge one portion of a hole in order to allow a bolt, screw head, or the like to set in flush with the surface.

COUPLING—A positive connection between two shafts.

COAMING—A strip of wood surrounding the cockpit and raised above the deck.

CRIB—Interlacing timbers loaded with stone and used to form a pier.

CRADLE—A framework for supporting a boat when out of water.

CRUISER—A type of motor boat having the forward portion of the cockpit enclosed in a cabin, and provided with berths and a galley.

CRANK SHAFT—The shaft containing the cranks to which the pistons of the motor are connected.

CYLINDER—The main portion of the motor. The casting in which the piston moves up and down.

CYCLE—A round of events. In the gasoline motor, it is the operations that take place between one ignition of the charge and the next.

Dead-Center—The top and bottom positions of a crank. Or, when the crank makes a straight line with the connecting rod. Under these conditions, the crank cannot be turned by the piston in question.

Deck—The roofed-over or covered portion of a hull. All that portion of the top of the hull not included in the cockpit or the cabin.

Differential Pulley—A self-locking hoist operated by chains and three pulleys of different sizes.

Electrodes—The metal terminations or points between which the current flows. In an ignition plug, they are the points between which the spark jumps.

Emery Cloth (or Paper)—A sheet over which a preparation of finely powdered emery has been spread. Used on metal in the same manner as sandpaper is used on wood.

Exhaust—The gases discharged from the cylinder after ignition has taken place.

Four Cycle—The type of motor in which the admission of the charge and expulsion of the exhaust gases are controlled by valves and in which four strokes, or two revolutions, are required between each explosion in each cylinder.

FANTAIL—A type of stern used on many sail and steam craft. In such a boat, the deck length is greater than the waterline length, for the stern deck projects far over the water.

GALLEY—The kitchen of a cruiser, ship, or yacht.

GASKET—A packing or lining placed between two adjoining parts to render the joint gas or water-tight.

GROMMETS—Brass eyes sewed into a canvas in order that it may be hooked in place.

GUNWALE—The upper side "edges" of the hull.

HANGER—The underwater support for the stern end of the propeller shaft.

HATCH—An opening in the roof or top of a boat to allow headroom when entering or leaving the cabin or cockpit.

HOLD—The space in a hull between the bottom and the lower deck.

HORSEPOWER—The power required to raise 33,000 pounds one foot in one minute. Or, the power required to raise one pound 33,000 feet in one minute.

HULL—The boat exclusive of cabin, machinery, or furnishings. The "part that floats."

HYDROPLANE—A racing type of boat which, by its shape, is designed to skim over the water instead of through it.

INBOARD—Applies to anything used inside the hull.

JACKET—The hollow space surrounding the cylinder walls in which the cooling water circulates.

JOINT—The point of contact between two separate parts.

KEEL—The heavy timber running throughout the length of the bottom of the hull which forms the "backbone" of the boat.

KILOWATT—A measure of electrical energy. One thousand watts.

KNOCKDOWN—Term applied to a boat that is so constructed that it may be easily taken apart and assembled.

LAG SCREW—A heavy screw with a square head used for holding timbers together.

LARBOARD—Nearly obsolete term for the port, or left-hand side, of a boat.

LEE—The side of a shore, boat, building, or the like protected from the wind.

LOG—The piece surrounding the shaft at the point where it pierces the keel. It is used to form a water-tight joint in the hull at this point.

MANIFOLD—The casting in which several pipes unite in a common outlet.

'MIDSHIP—Contraction for Amidship. The middle portion of the boat.

MIXTURE—Term usually applied to the combustible charge after it has left the carburetor.

MUFFLER—A cylinder into which the exhaust gases are introduced and allowed to expand in order to reduce the noise of the explosion.

NEEDLE-VALVE—The small valve in a carburetor that regulates the amount of gasoline admitted to the intake pipe.

NEUTRAL—The position of a reverse clutch or the blades of a propeller at which neither forward nor backward motion will be communicated to the boat.

ONE-MAN CONTROL—System by which one person may steer boat, run motor, and operate reverse.

OUTBOARD—Applies to any part of boat used outside of the hull.

PACKING—Material placed between two adjoining surfaces in order to form a tight joint.

PATTERNS—Forms by which the correct shape of a certain design of boat may be obtained.

PERIPHERY—The surface of a wheel at the greatest distance from its center.

PITCH—The distance that a propeller would travel in a straight line during one complete revolution if there were no "give," or slip. This distance is measured along the axis about which the propeller turns.

PISTON—The portion of the motor that fits the cylinder and moves up and down within it as the gas is exploded.

PISTON RING—A springy ring surrounding the piston and used to obtain a tight joint as the piston moves. There are generally four rings on each piston.

PLANKING—The boards that cover the ribs of the boat and constitute the outside of the hull.

PLUNGER—The piston of a pump.

POLES—The two portions of a battery from which the current is taken.

PORT—The opening in the cylinder wall through which the gases are admitted and expelled. In a two-cycle motor, ports take the place of valves.

Also, the left-hand side of a boat.

PORT (Two-)—A type of two-cycle motor in which the charge is sucked into the cylinder directly from the carburetor and intake pipe.

**Port** (Three-)—A type of two-cycle motor in which the charge is first sucked into the base and is there compressed before its admission to the cylinder.

**Propeller**—A metal wheel having two, three, or more blades set at an angle to its axis. When this is revolved under water on the end of a shaft, the boat is propelled forwards or backwards, depending upon the direction of rotation.

**Ratchet**—A toothed wheel and "dog" which enable rotary motion to be transmitted in only one direction.

**Rating**—A result obtained by a mathematical computation of measurements which is used as a basis of handicapping boats in speed contests.

**Register**—To set one hole or opening so that its outlines coincide exactly with those of the same-shaped opening adjoining it.

**Ribs**—Bent pieces of wood attached to the keel and to which the planking is nailed. The ribs and keel form the "skeleton" of a hull.

**Rings**—See piston.

**Shim**—Small pieces of sheet metal or composition placed between two halves of a bearing so that the pressure upon the shaft will not be too great. Also placed between the lugs of an engine base and its bed in order to hold the motor in the proper position so that it will line up with its shaft.

Shoal—A submerged sandbar or rock dangerous to navigation.

Skag—A rigid metal bar attached to the keel and extending under the propeller to protect the latter from shoals and other obstacles.

Skiff—A round-bottom rowboat having pointed bow and stern.

Sleeve—A tube surrounding part of a shaft which can be moved or revolved independently of the latter.

Slip—An opening cut in the floor of a boat-house for the accommodation of one or more craft.

Spark—The hot flame of electric current used in the cylinder to ignite the charge of gas from the carburetor.

Spontaneous Combustion—Heat generated by chemical action in a closed space. The cause of many "mysterious" motor boat fires.

Stanchion—The wooden or metal supports for a canopy top or overhead deck.

**Starboard**—The right-hand side of a boat.

**Starve**—To reduce the gasoline or mixture supplied to a motor to the extent that irregular running results.

**Step-Up** (Transformer)—The type of coil used on gasoline engines. This increases the original voltage and reduces the original amperage a proportionate amount.

**Stern**—The extreme rear of a boat. As an adjective, used to signify any part that is aft of the 'midship portion.

**Stroke**—The length of piston travel in a continuous direction. Or, twice the length of the crank to which the connecting rod is attached.

**Tap**—To cut threads in a hole drilled in a piece of metal.

**Teak**—A kind of wood sometimes used in the construction of hulls and engine beds.

**Tender**—A small boat usually towed behind a larger craft. Sometimes the tender is carried on top of the large boat, or is slung from davits at the side.

**Tiller**—The cross-piece attached to the rudder post that is used to turn the rudder. The cables, chains, or ropes that pass around the steering wheel are attached to the end of the tiller.

Timer—The device by means of which the moment of the formation of the spark is regulated.

Three-Port—See Port.

Throttle—The valve by means of which the amount of mixture admitted to the cylinder may be regulated.

Torpedo—A form of stern that projects beyond the deck line. The torpedo stern is the opposite of the fantail stern in that the waterline length of the former is the greatest measurement of the boat.

Transformer—Ordinarily termed the coil. The device used to increase the voltage of the batteries to an amount sufficient to form the necessary spark.

'Tween-Deck—The enclosed portion of the hull between the deck and the keel.

Two-Cycle—The type of motor in which the explosion occurs in each cylinder at each revolution.

Two-Port—See Port.

Universal Joint—A coupling that enables the two shafts connected by it to revolve at different angles.

V-Transom (Stern)—A form of stern having a V-shaped plan.

Valve—A device for controlling the admission or flow of a gas or liquid. In four-cycle engine practice, the valves are used to control the admission of the charge and the expulsion of the exhaust gases to and from the cylinder.

VIBRATOR—A piece of spring steel used on the top of a coil to make and break the current alternately in order to obtain the "surging" necessary to the increase in voltage.

VOLT—A unit of electrical measurement. It represents the pressure or force of the current as it flows from one pole to the other.

WASTE—A loose, stringy, cotton material useful for wiping and cleaning parts of a motor and boat.

WATT—A unit of electrical energy. The number of watts delivered by a generator is the product obtained by multiplying the amperes by the volts.

WAYS—The inclined track on which a boat is drawn when it is hauled from the water.

WHEEL—A term often applied to the propeller of a boat.

WINDWARD—The side of a boat, shore, building, or the like against which the wind blows.

THE END

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**The Airedale.** By William Haynes. This book opens with a short chapter on the origin and development of the Airedale as a distinctive breed. The author then takes up the problems of type as bearing on the selection of the dog, breeding, training and use. The book is designed for the non-professional dog fancier who wishes common sense advice which does not involve elaborate preparation or expenditure. Chapters are included on the care of the dog in the kennel and simple remedies for ordinary diseases.

**The Amateur Gunsmith.** Edited by Horace Kephart. Every man who owns a gun yields at some time or other to the temptation to take it apart. Usually he regrets having yielded to this temptation when it comes time to reassemble. This book is designed to aid the inquisitive and deft-fingered who do not care or are unable to turn the gun over to a professional gunsmith for repair. It is thirty years since anything of this sort appeared, and in that interval the local gunsmiths have practically passed out, leaving the gun user to depend entirely upon the experts of the large sporting goods dealers in the larger cities or the factory of the maker.

**The American Rifle.** By Charles Askins. The author has taken up in detail the various sporting rifles now in common use, and described their different advantages, with the maximum caliber and load for various game. An important feature is the discussion of trajectory and muzzle velocity as affecting range and accuracy. The book is designed especially with reference to the needs of the man who wishes to take up the use of the rifle or to find a new gun better adapted to the uses to which he wishes to put it.

**Apple Growing.** By M. C. Burritt. The objective point of this book is the home orchard with incidental reference to market possibilities. It deals with such matters as the kinds of apples best suited to certain localities, the location of the orchard and the soil qualities most to be desired, and the varieties that can be planted with a reasonable assurance of success. The whole problem of planting is dealt with thoroughly and also the care of the trees, and the harvesting and storage of the fruit.

**The Automobile.—Its Selection, Care and Use.** By Robert Sloss This is a plain, practical discussion of the things that every man needs to know if he is to buy the right car and get the most out of it. The various details of operation and care are given in simple, intelligible terms. From it the car owner can easily learn the mechanism of his motor and the art of locating motor trouble, as well as how to use his car for the greatest pleasure. A chapter is included on building garages.

**Backwoods Surgery and Medicine.** By Charles Stuart Moody. A handy book for the prudent lover of the woods who doesn't expect to be ill but believes in being on the safe side. Common-sense methods for the treatment of the ordinary wounds and accidents are described—setting a broken limb, reducing a dislocation, caring for burns, cuts, etc. Practical remedies for camp diseases are recommended, as well as the ordinary indications of the most probable ailments. Includes a list of the necessary medical and surgical supplies.

*The manager of a mine in Nome, Alaska, writes as follows: "I have been on the trail for years (twelve in the Klondike and Alaska) and have always wanted just such a book as Dr. Moody's Backwoods Surgery and Medicine."*

**The Beagle.** In this book emphasis will be laid on the use of the beagle in the hunting field rather than in the show ring. It is designed for the man who wishes to keep a small pack for his own enjoyment rather than for the large kennel owner. Simple remedies are prescribed and suggestions are given as to the best type for the purposes of purchase or breeding.

**Boat and Canoe Building.** Edited by Horace Kephart. It is not a difficult matter to build a boat or a canoe yourself. All that is necessary is to bring together knowledge, manual dexterity, and the proper material. The material can be secured almost anywhere at little expense. The manual dexterity will come with practice and this book furnishes the knowledge. All types of the smaller boats and canoes are dealt with and suggestions are given as to the building and equipping of the smaller sail boats.

**Camp Cookery.** By Horace Kephart. "The less a man carries in his pack, the more he must carry in his head," says Mr. Kephart. This book tells what a man should carry in both pack and head. Every step is traced—the selection of provisions and utensils, with the kind and quantity of each, the preparation of game, the building of fires the cooking of every conceivable kind of food that the camp outfit or woods, fields, or streams may provide—even to the making of desserts.
Every precept is the result of hard practice and long experience. Every recipe has been carefully tested. It is the book for the man who wants to dine well and wholesomely, but in true wilderness fashion without reliance on grocery stores or elaborate camp outfits. It is adapted equally well to the trips of every length and to all conditions of climate, season or country; the best possible companion for one who wants to travel light and live well.
The chapter headings tell their own story:
Provisions.—Utensils.—Fires.—Dressing and Keeping Game and Fish.—Meat.—Game.—Fish and Shellfish.—Cured Meats, etc.—Eggs.—Breadstuffs and Cereals.—Vegetables.—Soups.—Beverages and Desserts.

> *"Scores of new hints may be obtained by the housekeeper as well as the camper from Camp Cookery." —Portland Oregonian.*
> *"I am inclined to thing that the advice contained in Mr. Kephart's book is to be relied on. I had to stop reading his recipes for cooking wild fowl—they made me hungry." —New York Herald.*
> *"The most useful and valuable book to the camper yet published."—Grand Rapids Herald.*
> *"Camp Cookery is destined to be in the kit of every tent dweller in the country."*
> *—Edwin Markham in the San Francisco Examiner.*

**Exercise and Health.** By Dr. Woods Hutchinson. Dr. Hutchinson takes the common-sense view that the greatest problem in exercise for most of us is to get enough of the right kind. The greatest error in exercise is not to take enough, and the greatest danger in athletics is in giving them up. The Chapter heads are illuminating: Errors in Exercise.—Exercise and the Heart.—Muscle Maketh Man.—The Danger of Stopping Athletics.—Exercise that Rests. It is written in a direct matter-of-fact manner with an avoidance of medical terms, and a strong emphasis on the rational, all-round manner of living that is best calculated to bring a man to a ripe old age with little illness or consciousness of bodily weakness.

**Farm Drainage and Irrigation.** One of the most serious farm problems is that connected with water, either its lack or its too great abundance. This book gives the simple proved facts as to the best methods for taking water off the land or bringing it on. It shows the farmer how to bring his swamps into cultivation without converting them into sun-dried wastes. Also how the sandy stretches may be kept moist and bearing through even the driest summer. A knowledge of these simple facts will relieve the farmer from the haunting fear of drought or the long rains that sometimes blight the spring in Northern and Eastern latitudes.

**The Farmer's Bees.** The keeping of bees is neither a difficult nor expensive matter, nor is it one in which a little knowledge is necessarily a dangerous thing. However, there are a few elementary facts which could be well learnt, such, for example, as the handling of swarms and the provision of proper honey-making food and the care of the bees in winter. This book covers this elementary field in a logical and convincing manner.

**The Farmer's Bookkeeper.** Half of the secret of success in farming is knowing the real relation between income and expenditure. In no business is that so hard to find probably, as in farming. Mr. Buffum has presented a simple, common-sense method of farm accounting which he has used with great success for many years. It requires no elaborate knowledge of bookkeeping and is entirely reliable in showing the farmer where his business stands as a going concern.

**The Farmer's Cattle.** In this volume the problem discussed is two-fold, one of breeding and the other of care. The breed is determined largely by the use to which the farmer wishes his cattle put, whether for dairy or beef purposes. Their care is affected to a certain extent by the same consideration but not so largely. For the average farmer a combination of the two is usually most desirable, and it is in this light that this book discusses the problem. All of the information is designed to avoid unnecessary expense and to save the farmer from rushing into extreme and costly experiments or wasting his time on valueless mongrel strains. The care of calves is discussed in length, as also the stabling and feeding of milk cows and the feeding of the stock destined for the market.

**The Farmer's Hogs.** It was once the boast of Illinois, then the biggest grain producing state of the Union, that 90 per cent. of the corn raised in that state was fed in the country of its origin. Probably 70 per cent. of that amount was fed to hogs. That condition still holds in a large measure. Hence this book is designed to aid the practical farmer in selecting the best hogs for market purposes as well as for home use, and to advise him as to their care and feeding so as to insure a living profit on their cost and the cost of the grain necessary to feed them for market.

**The Farmer's Poultry.** It is a proved fact that there is large profit to be made from the raising of poultry but not by the amateur who rushes into it without knowledge or experience. In this book is given the fruit of many years experience of a man who has made poultry raising pay. The birds dealt with are not the expensive exotics of the poultry fancier but the practical varieties with records as good producers and a good name in the market. The reader is taught how to provide shelter for his poultry that shall keep them comfortable and safe from vermin of all kinds without involving the builder in prohibitive expense. The objective point is poultry as a by-product of the Farm that shall provide amply for the farmer's table with a margin for the market.

**The Farmer's Vegetable Garden.** This is designed especially for home growing with some reference, however, to the possibilities of market use of over supply. It gives the latest and best advice on the raising of the staple vegetables, such as potatoes, cabbages, beans, peas, turnips, and so forth. It also shows the farmer how, without material trouble or expense he may enrich his table with new varieties and lengthen the season of his garden's productiveness. It is a manual for the gardener who has only odd times to devote to his garden and its advice is intended to enable him to use that time to the highest advantage.

**Farm Planning.** It is a vexing problem with every practical farmer to get the greatest possible use out of his land with the least possible waste. A stony hillside is not suitable for the raising of wheat but it may furnish an excellent location for an orchard. A piece of swampy bottom land may not be ideal for barley but with proper drainage and cultivation it may be unexcelled for a vegetable garden. This book deals with just such problems and also with the placing of farm buildings, yards, and so forth, in order to make them fit in, so that the farm may be kept constantly at its highest pitch of usefulness.

**The Fine Art of Fishing.** By Samuel G. Camp. Combines the pleasure of catching fish with the gratification of following the sport in the most approved manner. The suggestions offered are helpful to beginner and expert anglers. The range of fish and fishing conditions covered is wide and includes such subjects as "Casting Fine and Far Off," "Strip-Casting for Bass," "Fishing for Mountain Trout," and "Autumn Fishing for Lake Trout." The book is pervaded with a spirit of love for the streamside and the out-doors generally which the genuine angler will appreciate. A companion book to "Fishing Kits and Equipment." The advice on outfitting so capably given in that book is supplemented in this later work by equally valuable information on how to use the equipment.

**Fishing Kits and Equipment.** By Samuel G. Camp. A complete guide to the angler buying a new outfit. Every detail of fishing kit of the freshwater angler is described, from rodtip to creel and clothing. Special emphasis is laid on outfitting for fly fishing, but full instruction is also given to the man who wants to catch pickerel, pike, muskellunge, lake-trout, bass and other fresh-water game fishes. Prices are quoted for all articles recommended and the approved method of selecting and testing the various rods, lines, leaders, etc., is described.

*"A complete guide to the angler buying a new outfit."*
—*Peoria Herald.*

*"The man advised by Mr. Camp will catch his fish."*
—*Seattle, P. I.*

*"Even the seasoned angler will read this book with profit."—Chicago Tribune.*

**The Horse, Its Breeding, Care and Use.** By David Buffum. Mr. Buffum takes up the common, every-day problems of the ordinary horse-user, such as feeding, shoeing, simple home remedies, breaking and the cure for various equine vices. An important chapter is that tracing the influx of Arabian blood into the English and American horses and its value and limitations. Chapters are included on draft-horses, carriage horses, and the development of the two-minute trotter. It is distinctly a sensible book for the sensible man who wishes to know how he can improve his horses and his horsemanship at the same time.

**Intensive Farming.** By L. C. Corbett. The problem as presented in this book is not so much that of producing results on a small scale because the land is no longer fertile enough to be handled in an expensive manner but rather one of producing a profit on high priced land, which is the real secret of intensive farming. This book will take up the question of the kind of crops, and method of planting and cultivation necessary to justify the high prices now being charged for farming land in many sections. Its publication marks the passing of the old style, wasteful farmer with his often destructive methods and the appearance of the new farming which means added farm profit and proper conservation of the soil's resources.

**Leather and Cloth Working.** Edited by Horace Kephart. This book is designed to give competent instruction in the making of the outdoor paraphernalia into which leather and cloth enter, such as tents, sails, sleeping bags, knapsacks, blanket rolls, and so forth. It has the double advantage of reducing the cost of the equipment and minimizing the risks of loss or accident when away from civilization. The cutting or patching of a sail or the repair of a sleeping bag may seem like a simple matter, but knowledge of how to do it may often spell the difference between safety and comfort or danger and a very high degree of discomfort.

**Making and Keeping Soils.** By David Buffum. This is intended for practical farmers, especially those who wish to operate on a comparatively small scale. The author gives the latest results as showing the possibility of bringing worn-out soil up to its highest point of productiveness and maintaining it there with the least possible expense. The problem of fertilization enters in as also that of crop rotation and the kind of crops best adapted to the different kinds of soil.

**The Motor Boat, Its Selection, Care and Use.** By H. W. Slauson. The intending purchaser of a motor boat is advised as to the type of boat best suited to his particular needs, the power required for the desired speeds, and the equipment necessary for the varying uses. The care of the engines receives special attention and chapters are included on the use of the boat in camping and cruising expeditions, its care through the winter, and its efficiency in the summer.

**Outdoor Signalling.** By Elbert Wells. Mr. Wells has perfected a method of signalling by means of wig-wag, light, smoke, or whistle which is as simple as it is effective. The fundamental principle can be learnt in ten minutes and its application is far easier than that of any other code now in use. It permits also the use of cipher and can be adapted to almost any imaginable conditions of weather, light, or topography.

**Planning the Country House.** The builder of a house in the country or in the suburbs is frequently forced to choose between two extremes—his own ignorance or the conventional stereotyped designs of mediocre architects and builders. This book provides a solution by presenting a number of excellent plans by an expert architect of wide experience in country house building, together with a plain statement of the problems which the builder must face, and the most suitable and advisable methods of solving them. A sufficient number of plans are presented for a liberal choice or to suggest the very house that the reader has been looking for.

**Rustic Carpentry.** Edited by Horace Kephart. Every year the number of dwellers in summer cottages of the smaller type increases and every year more and more people are giving attention to the beautifying of their own summer places with porch gates, fences, lawn seats, summer houses, and so forth. The country carpenter is not always available and frequently not dependable. This book answers the call for information as to how the owner of a summer house or summer cottage may be his own carpenter, building his own furniture, constructing his own porches, adorning his place with attractive fences, seats and so forth. Incidentally it opens the door to a most attractive way of spending one's leisure hours on a summer vacation.

**The Setter.** As the hunting dog "par excellence" the setter will only be treated with direct reference to his use before the guns. A practical method of putting a puppy through the necessary preliminary training before he takes the field, is described, as also the proper use of the broken dog in actual hunting or in field trials. As in our other dog books special attention will be given to the care of the dog in the kennels, type and qualities as affecting breeding, and simple remedies for the ordinary diseases.

**The Scottish and Irish Terriers.** By Williams Haynes. These two breeds are included in one book because of their general similarity of type, habits and use. Both have been increasing in popularity greatly in recent years. This book responds to a widely felt need for a common-sense manual which shall describe the breed, its noteworthy characteristics, points to be observed in selecting a dog, and the training of the dog after selection. Remedies for the ordinary diseases are described and advice given on the construction and care of kennels in a comprehensive and feasible manner.

**Sheet Metal Working.** Edited by Horace Kephart. Sheet metal enters into many of the articles that constitute an important part of the camper or canoeist's outfit such, for example, as baker's ovens, cups and pans, not to mention the numberless cans, boxes and cases which must find a place somewhere in the outdoor man's bags. This book teaches the reader how to obtain exactly the thing he wants because it teaches him how to make it himself. Also it is an excellent insurance against discomfort in the woods by its practical advice in the matter of rough and ready repair and refitting.

**Sporting Firearms.** By Horace Kephart. Mr. Kephart has done for the user of the shotgun, the rifle, or the revolver what he did for the camper and woods cruiser in "The Book of Camping and Woodcraft." All three arms are dealt with from the standpoint of the every-day non-professional user, and common-sense advice is given as to the makes, calibres, and types for the various uses. Even expert marksmen will find in this book possibilities of their favorite weapon suggested or described, of which they had not dreamt before.

**Tracks and Tracking.** By Josef Brunner. After twenty years of patient study and practical experience, Mr. Brunner can, from his intimate knowledge, speak with authority on this subject: "Tracks and Tracking" shows how to follow intelligently even the most intricate animal or bird tracks. It teaches how to interpret tracks of wild game and decipher the many tell-tale signs of the chase that would otherwise pass unnoticed. It proves how it is possible to tell from the footprints the name, sex, speed, direction, whether and how wounded, and many other things about wild animals and birds. All material has been gathered first hand.